THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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J. A. BERLY'S).

1911 EDITION

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THE COAL MINES BILL.

THE Standing Committee of the House of Commons on the Coal Mines Bill met on Tuesday and Wednesday of last week, and on both days the Government were defeated. In the absence of Mr. Masterman, the Bill was in charge of the Solicitor-General for Scotland, and on Tuesday an amendment was carried which instituted an eight hours day for colliery enginemen. As, however, the Government have insisted upon an eight hours day for other colliery workmen, it is a little difficult to see why they should object to an eight hours day for the engineman.

The more serious defeat, however, happened the following day, and one interesting feature about it was that on this occasion the amendment so carried against the Government was also most detrimental to the best interests of the mining industry. The matter under discussion was Clause 60, which contains restrictions as to the use of electricity, and Mr. Walsh, one of the Labour representatives, moved an amendment to prohibit the use of electricity in any mine where safety lamps were used, which, of course, was supported by the Labour party generally. This we may expect, and on more than one occasion we have referred to the almost incomprehensible attitude taken up by these men as being neither more nor less than playing to the gallery. They know nothing of the technics of electricity, and undoubtedly are quite possessed on one point, namely, that whatever the cost of production may be, it will be impossible for the coal owners in this country to close down their collieries. Since they must know that the introduction of electricity in coal mines has lessened the more arduous labour and increased the wages of the miner, and also that all attempts so far to saddle electricity with being the cause of the West Stanley and Hulton disasters have proved futile, no reasonable person can describe their attitude as other than both incomprehensible and foolish in the extreme. This particular amendment was defeated, fortunately for the miners themselves, but, unfortunately, its supporters gave their adhesion to Sir Arthur Markham's amendment, which was very little better than Mr. Walsh's, and it is difficult to understand what the honourable baronet could possibly have been thinking about. The amendment was to the effect "that electricity shall be discontinued in any place or part of a ventilating district of a mine, where the amount of inflammable gas in the air exceeds *one-half per cent.* or upwards until the air current is cleared." (The italics are ours.) "If the Committee carried this amendment" he (Sir A. Markham) continued, "they might say good-bye to *nearly all explosions in mines resulting from electricity.*" Again the italics are ours, and we would ask Sir Arthur, When and where have explosions resulted from the use of electricity? Surely he is not one of those narrow-minded people who believe all the clap-trap that has been uttered about

the dangers of using electricity in a gassy mine? Or does he believe, in spite of all evidence to the contrary, that the West Stanley and Hulton explosions were caused by electricity?

It is reported that all he asked was that the use of electricity should be made subject to the same standard as was imposed in connection with the use of safety lamps in mines, but this is a very different condition to that imposed in the actual amendment. In the former, no mine is to be worked *without* safety lamps when the average percentage of inflammable gas detected in six samples of air taken from the *main return airway* at intervals of not less than a fortnight amounts to ½ per cent. But there can be no comparison between ½ per cent. in the main return airway, and in a working place, and probably this amount could be found in the workings of a mine where naked lights are used with impunity. This limit of ½ per cent. is reasonable in determining whether a mine shall be worked by safety lamps or without, but it is absolutely absurd to apply the same limit at a working face to regulate the use of electrical machinery. Further, it is practically impossible for this amount of gas to be detected by an ordinary safety lamp; the Royal Commission on Mines, after giving great consideration to this question, decided that 2½ per cent. was the least that might reasonably be detected by an experienced workman, and why the majority of the Standing Committee did not realise this it is difficult to imagine. The Solicitor-General for Scotland, in expressing the Government's objection to the amendment, stated that in the opinion of experts one-half per cent. of inflammable gas was not necessarily dangerous, and further, the conditions could not easily be enforced, because there was no means of readily detecting in a practical way such a small amount. With this everyone who has any mining experience will readily agree. The Royal Commission, as mentioned above, fixed 2½ per cent. of firedamp as the condition under which workmen were to be withdrawn from the working place when using *safety lamps*, and 1¼ per cent. when using *naked lights*. Why, then, in the face of this should anyone, and more especially one who is supposed to have some knowledge of, and experience in, mining suggest that electrical machinery should only be allowed to work under conditions more onerous than these? There is not a single argument or a thread of evidence that can be adduced in favour of such an amendment, which is both foolish and mischievous as well as impracticable, and it is sincerely to be hoped that it will be either discarded in its entirety or at least altered to suit practical conditions. If the amendment stands it will have serious and far-reaching consequences in the mining industry, unless it be annulled by the Home Secretary, who has power to make regulations which will vary or amend any of the provisions contained in Part II of the Act.

As we have repeatedly pointed out, there is no danger in the use of electricity in mines if reasonable precautions be taken in its installation and operation. The Departmental Committee on Electricity in Mines, which so thoroughly investigated the whole question, expressed the same opinion, and it was only due to the possibility of inferior plant or workmanship being employed, and to err on the side of safety, that the rule was drafted prohibiting the use of electricity in any place where gas is given off frequently and in sufficient quantity to be detected by the ordinary safety lamp, which, taking the quantity as fixed by the Royal Commission, would be limited to 2½ per cent. It is evident that the consequences of such an amendment as that adopted have never been considered by the members of the Committee, for it would debar electricity from being used for shot firing, miners' hand lamps, and even electric signalling. Where explosives of the permitted class are used, it is one of the regulations that these shall be fired by electricity, and without explosives many mines would undoubtedly have to be closed. Sir Arthur and his supporters may not unnaturally scout this idea, and say there is no comparison between low-tension apparatus used for such purposes and electrical haulages or coal-cutters, but it is only a question of degree, and we repeat that, with well-constructed apparatus, the latter can be rendered as safe as the former. Further, a brief inspection of the reports of H.M. Inspectors of Mines will soon show whether more danger is to be apprehended from the use of explosives than from the worst-constructed electrical apparatus. Accidents due to electricity form a remarkably small percentage of the fatal accidents in mines, and every serious explosion has usually been traced to one of two causes, namely, a faulty safety lamp or a blown-out shot.

We sincerely trust that a more reasonable counsel will prevail, and that the amendment will not find a place on the statute book, and we would recommend Sir Arthur Markham and all others of like opinion to investigate a little more closely the best practice relating to electrical apparatus for use in mines, when we have no hesitation in saying they will at once admit, like worthy Britons, that they are in the wrong.

Bang went Saxpence.

A SHORT paragraph in the agenda for the Hammersmith Borough Council meeting this week appears to be worthy of some notice. The Electricity Committee have been considering the question of popularising the uses of electricity, having plunged last year to the extent of £50 for publicity literature, and in the paragraph in question they say "we are now strongly of opinion, having regard to the active methods pursued by the gas companies, that the Council should authorise the Committee to undertake, on a larger scale than hitherto, the distribution of literature and the general advertising of their electric supply. We also consider that it would be advantageous that actual demonstrations of the advantages of using electricity should be given when considered desirable. For this purpose we consider that a sum of not less than £300, which does not amount to one per cent. of the revenue of the undertaking, should be set aside, this amount to include the annual salary of the canvasser, amounting to £156." The Council agreed to expend £300 in this way.

Reckless enterprise of this sort is irresistible—the "active methods" of the gas companies are to be met by an expenditure of *less than one per cent!* of the revenue of the undertaking. Exactly how the great feat is to be accomplished, we don't know—but, no doubt, the secret of safeguarding the business of a commercial undertaking by an expenditure of less than one per cent. of its revenue will not remain a secret long. Perhaps the gas companies may be able to throw some "light" on it.

LARGE GAS ENGINE PROGRESS.

ON the 19th inst. we had the pleasure of inspecting a very fine example of a large Ehrhardt & Sehmer type gas engine, constructed by Messrs. Galloways, Ltd., at their Knott Mill Works, Manchester.

This engine, as no doubt our readers will be aware from previous articles in our columns, especially that in our issue of October 25th, 1907, is of the horizontal tandem type, with double-acting four-cycle cylinders; such an arrangement gives a turning moment at the crankshaft equal to that of the ordinary double-acting steam engine. The engine inspected develops a maximum of 1,350 B.H.P. at 105 R.P.M., and will operate upon producer gas, driving an 800-KW. alternator day and night for months at a time without stopping, at a large English chemical works. Two similar engines by Messrs. Ehrhardt & Sehmer have been running successfully at these works on Mond gas, for about five years and one year respectively. The engine is of massive construction, but is designed on simple lines, and with an entire absence of all unnecessary details, which in Continental designs are usually so prominent, and in practical operation are a frequent source of trouble. In fact, Messrs. Ehrhardt & Sehmer in their designs have kept consistently in view the requirements of the operating engineer.

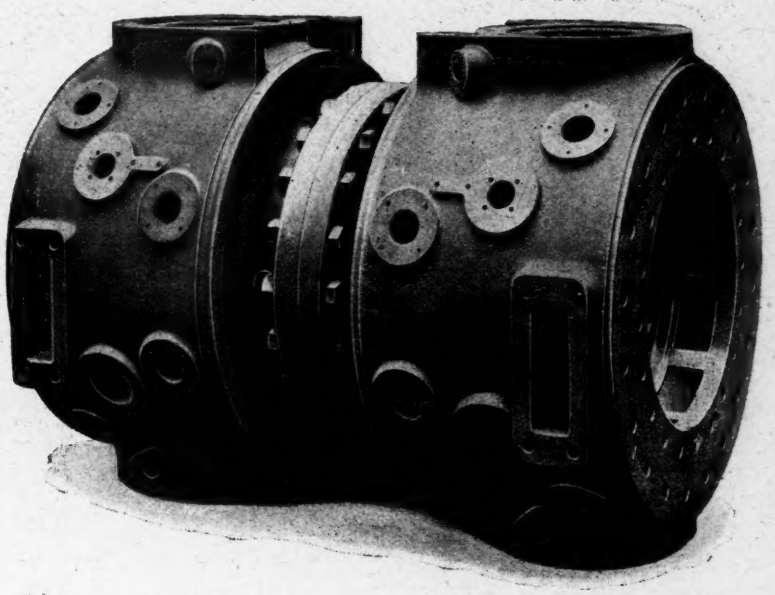

FIG. 1.—BUILT-UP CYLINDER, WITH JACKET CASING REMOVED, SHOWING FLANGE JOINT.

Messrs. Galloways, it may be remarked, are working strictly to the working drawings, and with the fullest technical assistance of Messrs. Ehrhardt & Sehmer, who have built about 150,000 B.H.P. of these engines within the last seven years, the engines being of an average size of over 1,200 B.H.P.

A special feature of the engine built by Messrs. Galloways is the patent built-up cylinder, which is now exhibited publicly for the first time in England. Until recently Messrs. Ehrhardt & Sehmer followed the practice usual amongst large gas-engine makers of casting each cylinder in one piece. Such a cylinder consists of an inner, or working, barrel and an outer barrel or jacket casing connected by the end flanges, and no fewer than 12 necks for the valves, igniters, &c. A casting of this kind is exceedingly complex, and in practice, owing to unequal cooling in the foundry moulds, is never obtained free from initial casting stresses. Furthermore, when working, the explosions heat up the inner barrel, causing it to expand, whilst the outer barrel, being in contact solely with cold water and cold air, does not expand. Consequently the outer barrel or jacket casing resists the expansion of the inner barrel, and very serious bending stresses are transmitted through the valve ports. These are further exposed to extreme high temperature on one side, and frequently are inadequately cooled on the other side of the metal, so that

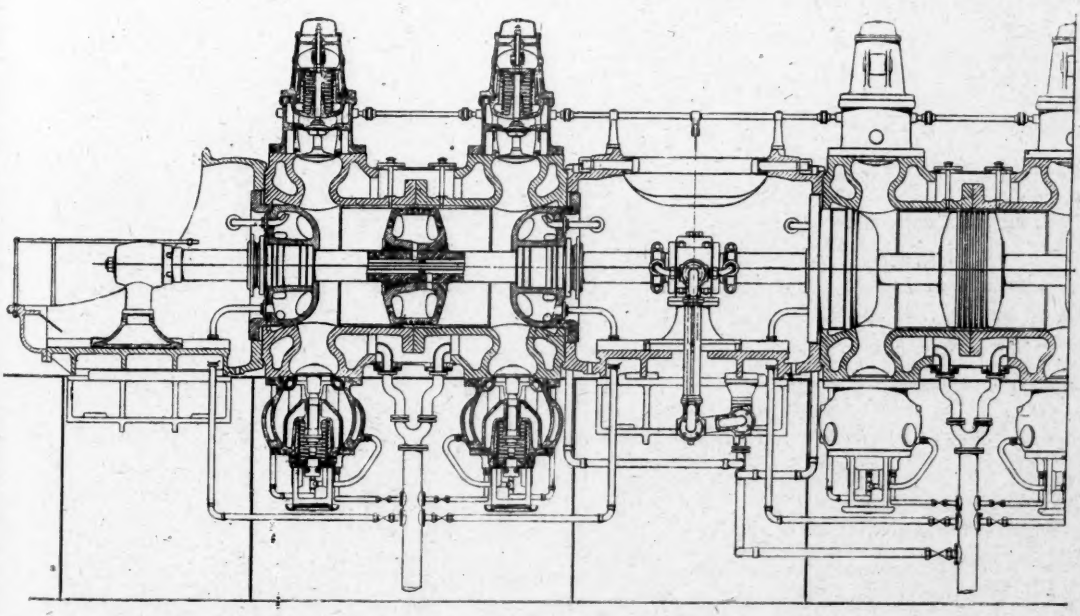

FIG. 2.—SECTIONAL ELEVATION OF GALLOWAY-EHRHARDT AND SEHMER GAS ENGINE CYLINDERS.

Cylinders, 37·4 in. diameter, 43·3 in. stroke. Weight of engine, 160 tons; fly-wheel, 50 tons; total 210 tons. The bedplate casting weighs 28½ tons.

cracks are started at the junctions between these ports and the inner cylinder barrel. These cracks extend, and ultimately cause the breakdown of the cylinder.

In the new built-up design the main cylinder body is constructed of two separate symmetrical castings, bolted together at a transverse flange joint midway between the two cylinder ends. Each of these castings is comparatively simple, and is readily obtained quite sound and free from initial stresses. In the new design the jacket casing is not now solid with the cylinder, but consists of a detachable rolled steel band, split longitudinally in halves, and clipped on to the cylinder castings through thick rubber jointing rings. This jointing forms an expansion coupling, and the cylinder casing in no way prevents the free expansion of the inner, or working, barrel of the cylinder under the influence of heat and stress. Hence this new construction eliminates both casting stresses and expansion stresses.

The new cylinder has also several other advantages to which attention may be drawn. It will be noted from the cross-sectional drawing that the cylinder is fitted with a liner, which is prevented from working loose by means of a collar on its outer surface, which is held between the two flanges of the cylinder. This liner is made of special wearing metal, as it is not required to carry any stress. On the other hand, the cylinder body proper is not subject to rubbing action, and is made of specially strong and tough metal to withstand explosive pressure. In the old design, the cylinder being in one piece, a compromise between strength and wearing properties had to be adopted. Furthermore, when after a lapse of time it is necessary to renew the cylinder liner, this can readily be done, whereas, with a single-piece cylinder, the entire cylinder had to be replaced.

A further advantage of the built-up cylinder is to be found in the accessibility of the water jackets. The jacket casing can be removed in a few minutes, and the entire water space thoroughly inspected and cleaned, a point of very great importance.

The valve gear of the engine has also been greatly simplified, the old-fashioned mixing valves with trip cut-off arrangements having been abolished, and their place taken by a simple gas valve on the main inlet valve spindle, and a throttle valve on the gas supply pipe, the latter being under the control of the governor.

The Ehrhardt & Sehmer gas engine embodies a number of other patent features in addition to the built-up cylinder, which the makers believe marks a revolution in large gas-engine cylinder design.

The main frame is in one piece, with the pedestals and crank race cast in; the cylinders and frames are connected by bored and turned joints, securing perfect alignment. The cylinders are carried entirely by the frames, but the back and intermediate frames slide in machine-grooved foundation plates, so that expansion stresses are obviated. The pistons and rods are water-cooled, and have proved very satisfactory. The cross-head is of a special patented design, and can be removed from the piston rod even when the nuts are bound fast. Ignition is effected by the "Lodge" high-tension system, in duplicate at each end of the cylinder, sure starting and reliability of running being ensured by this means. The highly successful results obtained in the past with the Ehrhardt and Sehmer engine, which have been greatly added to since, in 1907, we first described the pattern then constructed, give every reason to believe that the new design, which embodies many important improvements upon the former, will prove that a good gas engine is as reliable in running and as cheap to maintain as a good steam engine. Thus the undoubted prejudice which exists in the minds of supply station engineers in this country against the large gas engine, and which has certainly not been without justification in the past, may be dispelled, and the day of gas-power stations will be brought one stage nearer.

Hydro-electric Power in Canada.—Dispatches from Edmonton state that a by-law to provide the sum of $100,000 for an initial section of the municipal plant at Grand Rapids on the Athabasca has been defeated. It was said that the scheme was too big for the city at present, and that it would have cost nearly $4,000,000 to complete.

VIBRATING WIRES AND THE MEASUREMENT OF DISTANCE.

By C. A. SMITH, A.Am.I.E.E., Birmingham.

UNDER the above heading, the writer wishes to place before those engineers whose business it is to superintend and control the working of aerial wires, the results of a number of successful experiments which he has recently conducted, with a view to determine distance by means of vibrating wires.

Every student of physics will, no doubt, remember the laboratory experiments on the propagation of transverse waves along a stretched wire or cord, and the fundamental law deduced therefrom, viz., that the velocity of propagation is expressed thus:

$$v = \sqrt{\frac{T}{m}}, \quad \ldots \ldots \ldots \ldots \ldots \quad (1)$$

where T is the tension applied, and m is the mass of unit length of the wire, in absolute units.

The writer has found that these experiments can be usefully extended to the measurement of distances, over which aerial lines are strung, with very close results.

The method is both accurate and simple, and should have an important application to the measurement of distances between poles or wire supports, when the bases are inaccessible. Such cases frequently occur where the wires cross over house property, and particularly abroad, where they pass over mountain gorges, and over water or swamps.

The usual method resorted to by telephone and telegraph men in cases of this kind is to cut a wire and attach a cord to it. After the cord has been drawn across the space and tightened up, an indication knot is made in it. Then the cord and wire are pulled back and the wire joined again. Afterwards the cord is measured up on the ground.

Such a procedure, while good enough in many instances, is only an approximate expedient, and requires the services of several men. Then, as often as not, it means the cutting of a working wire—an objectionable feature.

Another method, still more approximate, is to measure the distance on an ordnance map.

The first of these two methods is rendered inaccurate by the stretching of the cord, and sag, while the second one may be considerably out owing to inaccuracies in the plan itself, or shrinkage of the paper.

Trigonometrical determinations and the use of the theodolite for such purposes are, of course, out of the question.

The method about to be described can be readily applied by the engineer himself, either with or without the assistance of one man only.

Referring to the propagation of wave motion in a horizontally suspended wire, supported at both ends, if the wire be struck, or "plucked," near one end, a transverse wave results, which travels at a uniform

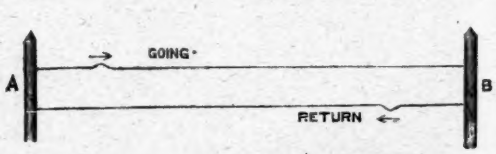

FIG. 1.—TRAVELLING WAVE ON A SINGLE WIRE.

velocity to the distant end. On reaching the far end, it is reflected, and continues to traverse the wire to and fro several times, always maintaining the same velocity, but gradually falling in amplitude.

Fig. 1 shows diagrammatically a going and return wave, travelling along a single wire, in exaggerated form.

Since the velocity is uniform, it follows from the above equation (1) that, if we know the exact time in seconds taken for the pulse to reach the distant end, also the tension applied to the wire, and its weight per unit length, it becomes a simple matter to calculate the length or distance traversed. The following description of my experiments will make the matter clear:—

An accurate dynamometer (fig. 2) is attached to one end of the wire, which need not be cut, and with it the wire is

drawn up to several tensions, which are noted. At each tension the wire is struck at a convenient distance from the draw-tongs attached, and the exact time observed for the 5th return wave to reach the experimenter's hand, held on the wire. This time interval is divided by 10, to give the time taken for the wave to travel in one direction. A ⅕th-second watch is best suited for this purpose, and the mean of several readings should be taken at each tension and noted.

If these readings are then plotted as ordnates, T and t, on squared paper, a curve of the shape given in fig. 3 will be obtained, if carefully drawn. Then if, say, three points a, b and c well spaced along the curve be taken, the correct distance between the poles can be calculated from the following empirical formula (2) by applying it to the three pairs of values so found, and then taking the mean of the results—

$$D \text{ (feet)} = t\,(c \times T)^{\cdot 503} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Where t is time of outward wave; c is 30·5/w, a constant; w is weight of 1 ft. of the wire in lb. to four significant figures.

This equation having the exponent ·503 instead of ·5 in the equivalent expression to (1), has, for some reason or other, been found necessary to give correct distance, and is independent of sag. It also holds good for any kind of wire used for aerial lines.

Still more accurate results can, however, be had if logarithms of the tension and time are plotted instead of the natural numbers. In this case we get a straight-line curve, which can be more easily drawn through the points, and the three points chosen from it, which would be used in logarithm form in the equation, will be nearer the true values required (see fig. 4).

The curves given herewith were drawn from the data contained in the table, and correspond to an actual experiment made upon a No. 14 iron wire, weighing 89 lb. per mile, strung between two trees 220 ft. apart.

TABLE.

T in lb.	Log T.	t in secs.	Log. t	Constant.
30	—	·90	—	
40	—	·76	—	
51	1·7076	·70	$\bar{1}$·8451	
60	1·7782	·64	$\bar{1}$·8062	
71	1·8513	·59	$\bar{1}$·7709	
82	1·9138	·54	$\bar{1}$·7324	
94	1·9731	·51	$\bar{1}$·7076	
104	2·0170	·48	$\bar{1}$·6812	
113	2·0531	·46	$\bar{1}$·6628	
122	2·0864	·44	$\bar{1}$·6435	
135	2·1303	·42	$\bar{1}$·6232	
142	2·1523	·41	$\bar{1}$·6128	
150	2·1761	·40	$\bar{1}$·6021	
164	2·2148	·39	$\bar{1}$·5911	
172	2·2355	·37	$\bar{1}$·5682	

Weight per foot = ·01689 lb.
Constant c = 1,806.

The following six experiments were also made upon different wires of various lengths :—

No.	Actual distance.	Calculated distance.	Error %
1	499·5 ft.	499·3 ft.	0
2	336·0 ,,	337·0 ,,	+ ·30
3	220·0 ,,	217·5 ,,	— 1·13
4	533·0 ,,	537·0 ,,	+ ·75
5	406·0 ,,	403·0 ,,	— ·74
6	297·0 ,,	300·0 ,,	+ 1·00

The factor of greatest importance, and the one which requires close attention, is the reading of time. One fifth of a second, although easily read with a little practice, is sufficient to throw out the measurement considerably.

As a converse measurement to distance by the same method, if the exact distance be known in feet, the tension of a given wire can be closely calculated, rendering a dynamometer unnecessary, by the following expression :—

$$T \text{ (lb.)} = \frac{w(D/t)^{1\cdot 967}}{30\cdot 5} \quad \ldots \quad \ldots \quad (3)$$

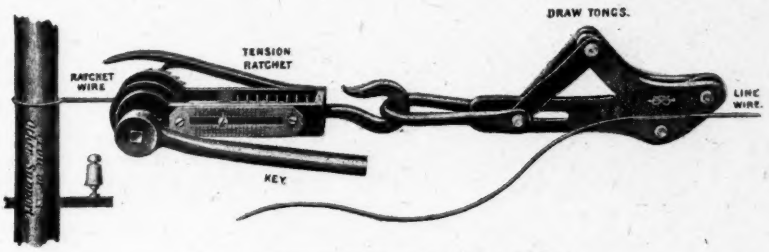

FIG. 2.—DYNAMOMETER FOR AERIAL WIRES.

I find from my experiments that the tension so determined agrees within 5 per cent. always, with an average of 2 per cent., above or below the actual values given by the dynamometer.

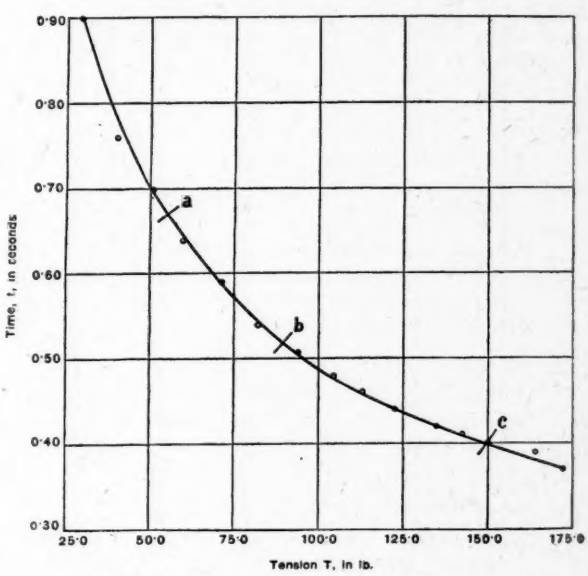

FIG. 3.—ORDINARY CURVE, NO. 14 IRON WIRE.

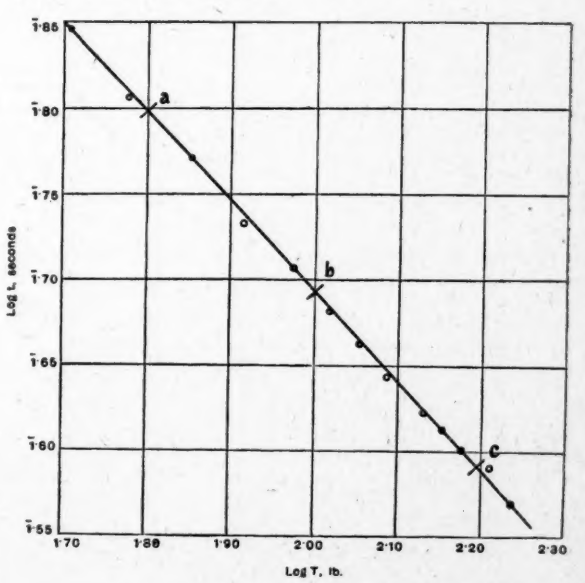

FIG. 4.—LOG CURVE, NO. 14 IRON WIRE.

To expedite the brief mathematical operations involved, the engineer would, of course, keep on record the weights

per foot, W, and the constants, C, in his notebook. These weights and constants for the wires employed in the six experiments referred to were :—

Wire.	Weight per foot.	Constant.
No. 14.—Iron	·01689 lb.	1,806
No. 14.—Copper...	·01890 lb.	1,614
No. 16.—Steel	·01095 lb.	2,786

But as these values vary with different makers, they should be occasionally checked.

Finally, to assist those not conversant with curves, and the mathematical deductions, I append two examples taken from the above curves, for No. 14 iron, length of span known to be 220 ft. :—

Example 1.—Curve fig. 3.

Taking middle pair of values only, viz. :—Tension = 90 lb. and time = ·52 second.

We have from (2)—

$$D = \cdot52\,(1{,}806 \times 90)^{\cdot503}$$
$$= \cdot52\,(162{,}540)^{\cdot503}$$
$$= \cdot52 \times 417{\cdot}8$$
$$= 216 \text{ ft.} \quad \text{Difference} = -4 \text{ ft.}$$

Example 2 :—Curve fig. 4.

Taking $\log T = 2{\cdot}000$

and „ „ $t = \bar{1}{\cdot}692$

We have :—

$$\log D = \log t + \cdot503\,(\log C + \log T)$$
$$= \bar{1}{\cdot}692 + \cdot503\,(3{\cdot}2567 + 2{\cdot}0000)$$
$$= \bar{1}{\cdot}692 + 2{\cdot}646$$
$$= 2{\cdot}338 = 217{\cdot}8 \text{ ft. (218 ft.),}$$

or a difference of − 2·0 ft., which shows, as my experience indicates, that the logarithmic method is the more accurate of the two.

As a further test in the converse rule to find the tension on a given wire, suppose the same wire, No. 14 iron, and span of 220 ft. be taken.

If the time t of wave be ·438 second, then the tension on the wire is, from log curve, and (3) :

$$\log T = \log W + (\log D - \log t)\,1{\cdot}987 - \log 30{\cdot}5$$
$$= \bar{2}{\cdot}2276 + (2{\cdot}3424 - \bar{1}{\cdot}6415)\,1{\cdot}987 - 1{\cdot}4843$$
$$= \bar{2}{\cdot}2276 + 5{\cdot}3680 - 1{\cdot}4843$$
$$= 2{\cdot}1113 = 129{\cdot}2 \text{ lb., instead of 126 lb.}$$

or a difference of + 2·5 per cent. Nearer results can generally be had, especially with copper wires. Most of these tests were made during windy weather, which might have had a disturbing influence.

Of course, the dynamometer used in the distance measurements must be accurate, and should be set aside specially for the purpose.

The writer found, after trying several different makes, that the improved form of dynamometer and vice, shown in fig. 2, which was made by Messrs. Geo. Salter & Co., of West Bromwich, and kindly lent to him by them, was the best suited to his purpose. It was found to be quite accurate, and was beautifully made. These are supplied with double draw tongs, *i.e.*, they have two distinct jaws, to take two sizes of wire for which the dynamometer is designed. The sets are supplied by this firm in two standard sizes. The smaller indicates from 0 to 150, 160, and 170 lb., and the larger one, up to 400, 600, 650 or 672 lb. All draw tongs have jaws of phosphor bronze.

Electricity Supply at Honiton.—At a meeting of the T.C. last week the Lighting Committee recommended that an agreement be drawn up with Dr. Purves (Exeter) for supplying the town with electric light. A letter had been received from the Honiton Gas Co. asking the Council to sanction its applying for provisional powers for supplying the town with electric light. The Committee, however, much as it would like to help the local company, regretted it was impossible to do so, as matters had gone too far with Dr. Purves. In certain places the mains would be carried underground, and in others overhead. The contract was to be completed within 18 months, otherwise the agreement would lapse. A penalty clause, providing for the payment of £10 per day, had also been added, in case of the conditions of the agreement not being carried out. The Council decided in favour of the agreement.

SOME PROTECTIVE RELAYS FOR ALTERNATING-CURRENT CIRCUITS.

BY KENELM EDGCUMBE.

OF the many relays in use, the present article deals only with those which are intended to open a circuit-breaker, as a means of protection from the ill-effects of some abnormal condition, such as a short circuit or an "earth."

It might, at first sight, appear to be a retrograde step, on the score of simplicity and economy, to employ a relay at all for this purpose, instead of operating the circuit-breakers direct. In the case of low-tension systems this is probably correct and, particularly in continuous-current work, the use of such relays is so limited that it is not proposed to deal with them. On a high-tension alternating-current system, however, the case is quite different and, although various attempts have been made to dispense with their use with a view to economy, their installation has now become almost universal.

The use of such relays is based upon three main considerations :—

1. The possibility of insulating the tripping mechanism from the high-tension circuit.
2. The convenience of being able to affect all adjustments to time-lag, tripping current, and so forth at the switchboard instead of at the breaker itself.
3. The power available for the direct operation of circuit-breakers is often insufficient, particularly in the case of those of the reverse pattern.

As regards the first mentioned feature, a relay is by no means essential, seeing that a transformer having its primary in the high-tension circuit and its secondary connected to

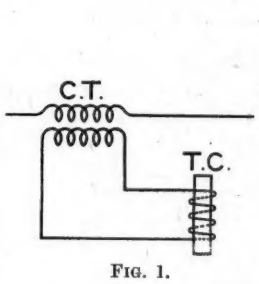

FIG. 1.

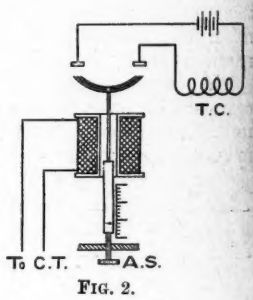

FIG. 2.

the tripping coil of the circuit-breaker would obviously meet the case. This arrangement is shown in fig. 1, where C T represents the current transformer, and T C the trip coil of a circuit-breaker.

The second and third considerations, however, are extremely important, and the second, in particular, is becoming daily more so, owing to the increasing size of power houses, and to the growing tendency to place the circuit-breakers, and the switchboards controlling them, at greater and greater distances from one another.

Protective relays may be divided, broadly, into four classes, according to the nature of the protection to be afforded :—(1) Overload relays; (2) no-voltage or minimum relays; (3) reverse or discriminating relays; (4) differential or balanced relays.

Overload Relays.—Probably the simplest form of relay for this purpose consists in a solenoid having an iron core which is attracted so soon as the current flowing in the coil exceeds a certain pre-determined value. Such a device is shown in fig. 2. Directly the core is raised, the contacts at the top are closed and the trip coil of the circuit-breaker (T C) is energised. By means of the adjusting screw A S, the position of the iron core in the coil can be altered, and the current at which it will act thereby varied over a comparatively wide range, the actual value in amperes being usually marked upon a scale, as shown.

In the majority of cases it is wished to add some form of time-lag device so that, on the occurrence of a momentary overload, the breaker will not trip, although doing so if the overload is maintained. It is often stipulated, further, that

the interval of time which elapses between the occurrence of a fault and the opening of the breaker shall be considerably less with a severe overload than with a moderate one. This is sometimes spoken of as an "inverse time element." A simple device which will occur to every one is to add an air or liquid dashpot to the iron plunger. Such an arrangement fulfils all the requirements of an inverse time element, since the stronger the pull, the shorter will be the time interval. It is, however, rendered almost useless with this particular form of solenoid, at any rate, by the fact that as the core is drawn up it gets into a more and more effective part of the magnetic field, so that, when once started, the plunger may continue to travel upwards, even when, in the meantime, the current has fallen to its normal value, and the breaker is thus tripped quite needlessly.

To overcome this objection, a most ingenious time-lag device was introduced some years ago by Mr. J. G. Statter. It consists in a smooth metal disk attached to the lower end of the iron plunger of the relay and resting upon a fixed plate covered with a film of some viscous liquid. It is found that an extremely small force applied continuously is sufficient to separate the two surfaces, whereas, to do this suddenly entails the application of a very much larger one, thereby giving the inverse time feature required. Moreover, the core is held stationary until it is completely freed, so that

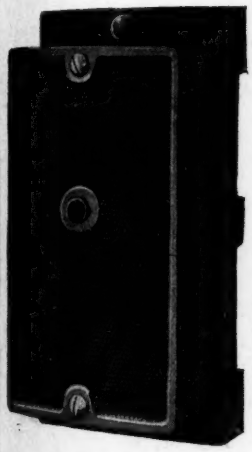

FIG. 3.

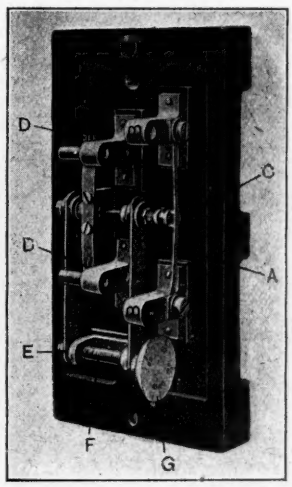

FIG. 4.

no "creeping" can take place with a reduced load. Besides this, the contact is made with considerable force, owing to the momentum of the plunger. The only drawback to this device lies in a slight indefiniteness of time-lag owing to variations in the viscosity of the oil due to time or to changes of temperature.

Referring again to fig. 1, if the trip coil T C has a fuse connected across its terminals, of such a capacity that it will blow when the required secondary current is flowing, an inverse time feature will be given to the combination. Under normal conditions, most of the secondary current flows through the fuse, whereas, as soon as this blows, the current is diverted through the trip coil, and the circuit-breaker is operated. A certain interval of time will necessarily elapse before the blowing of the fuse, depending, other things being equal, upon the magnitnde of the overload.

The thermal relay (shown in fig. 3 and, with cover removed, in fig. 4) has many advantages over the simple fuse, as an inexpensive relay for general work. Its construction is as follows: The curved strip A of resistance material is fixed at each end to the blocks B B, and is connected to the secondary of a current transformer in the circuit to be protected. Under normal conditions, the small spring catch C is held down under the strip A, so that the contacts D D, carried by the same arm as the catch C, are held open. This arm is pivoted at the farther end E, and is pressed upwards by the spiral spring F, so that, directly the strip A expands sufficiently to release the catch C, the latter flies up, and the contacts D D are closed. A simple attachment is provided whereby the current setting may be adjusted to any value between full-load and, say, 200 per cent. overload by means of a screw carrying an index, which moves over a graduated scale G.

This relay possesses, as has been said, several advantages over the fuse previously alluded to. For example, it is possible to set the tripping current to a nicety by means of

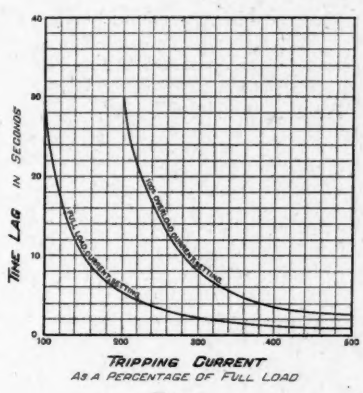

FIG. 5.

the attachment just mentioned, and, again, to reset the relay, it is merely necessary to depress an ebonite knob (see fig. 3), instead of having to replace a fuse. Moreover, the time-lag and current setting can be determined once for all, instead of involving the unavoidable uncertainties of a fuse. Fuses have, of course, low cost to recommend them, but the thermal relay just described is so simple in construction that there is but little difference even in this respect.

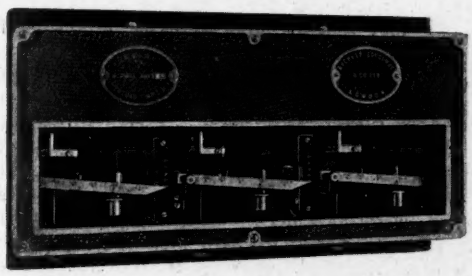

FIG. 6.

Fig. 5 shows typical time curves of this thermal relay, and it will be noticed that the curves have no tendency to meet, which, as will be seen later, is a most important consideration.

Undoubtedly the best overload relays are those working on the induction system. Fig. 6 shows one form of such an instrument, the working principle being indicated

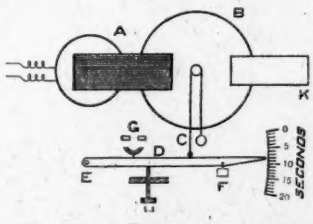

FIG. 7.

diagrammatically in fig. 7. The exciting coil (A) is usually connected to the secondary of a current transformer, and is provided with a copper ring which screens some two-thirds of the pole face, thus producing a phase displacement between the two magnetic fields, and exercising a torque on the copper disk B. This disk, which runs in centres, carries a small pulley, round which passes a silk cord C. One end of this cord is attached to the lever D, pivoted at E, while the other end terminates in a small weight serving to keep the cord taut. An adjustable weight F attached to this lever, keeps the latter pressed down against the screw H

until the torque exerted by the electromagnet on the disk is sufficient to lift it. So soon as this occurs, the lever commences to travel upwards and finally, after a certain interval of time, closes the relay contacts G. The time which elapses between the occurrence of a sufficient overload to cause the lever to travel upwards and the closing of the contacts, naturally varies with the magnitude of the current flowing in A. In order to increase this interval, a horse-shoe magnet K is provided which induces eddy currents in the disk.

The adjustment of the current setting is made by means of the weight F, the position of which is variable along the lever D, the usual range allowed for being from full load to

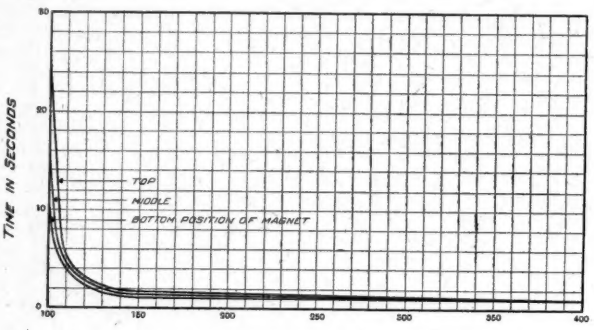

FIG. 8.

200 per cent. or 300 per cent. overload. Both the current and time-lag scales, which are entirely independent of one another, are seen in fig. 6.

In several forms of induction relay on the market, the adjustment of time-lag is carried out by altering the magnetic damping by moving the magnet nearer to, or further from, the centre of the disk. Such an arrangement is, however, far from satisfactory. Fig. 8 shows a typical set of curves representing the time-lag corresponding to three positions of the magnet in such a relay. It will be noticed that with an overload corresponding to three times the full load, the time-lags of all three curves are identical, viz., about one second. Hence it follows that if two relays are connected in series, the one being set for a greater time-lag than the other, with a view to ensuring that it will trip first, they may both trip at the same moment if subjected to an overload exceeding

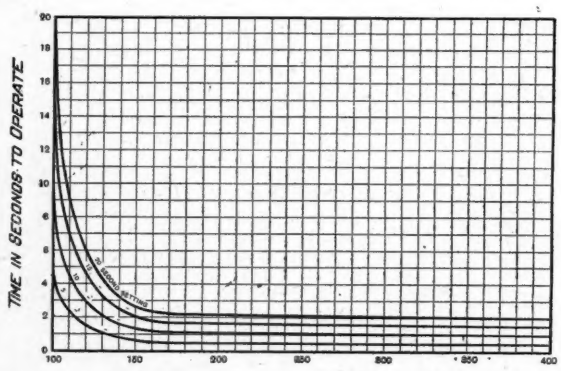

FIG. 9.

three times the normal full load, so that all discriminating action is lost.

By "discriminating action" is meant that if two or more breakers are connected in series at different points on the system (for example, one on a feeder connecting the generating station with a sub-station, and another on a feeder leaving the sub-station) it must be possible so to set the time-lags that, no matter what may be the overload, the relays, and with them their respective circuit breakers, will always act in the same order. This is a question of fundamental importance in relay design, which has not by any means received the attention it deserves. Many relays are excellent as regards their discriminating action over a certain range, but are far from being so on a heavy overload, which is precisely the occasion on which this is of particular importance.

The reason for the meeting of the time curves in fig. 8 is that the distance travelled through is always constant, and that the disk will not run above synchronous speed, however great may be the excitation of the electromagnet. In this particular instance, synchronous speed evidently corresponds to one second, and this time cannot, therefore, under any circumstances, be reduced. In the case of some other relays on the market, particularly those of the solenoid pattern with dash-pot time-lags, the time interval, above a certain overload, becomes practically zero, so that in this case also all discriminating action is lost.

In the relay illustrated in fig. 6, on the other hand, the time setting is adjusted, not by varying the damping but by altering the number of revolutions made by the disk before contact is made. This is effected by means of the screw H. Fig. 9 shows typical curves obtained with this instrument, and it is clear from these that, no matter how great may be the overload, it is impossible for any number of relays connected in series to trip in the wrong order. In specifying time-lag relays this question should be given due consideration, as a failure to do so almost invariably leads to trouble afterwards.

(To be continued.)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Cheap "Stannos" Wiring.

With reference to my letter kindly inserted in this week's issue of your paper, I would point out that the figure of 83 ft. should read 33 ft. This is evidently a printer's error.

Engineer.

I must thank "Engineer" for pointing out my mistake in the cost of Stannos wire, the cause of this error being a misprint in the catalogue. I have since referred to the invoice, and I find that the correct figure per 110 yd. is £1 14s. 9d., this bringing the cost per point to 9s. 4d. Seeing that this includes service cable and sealed fuse-box, I think you will admit the cost is low. I do not consider a main switch necessary on these small jobs.

No circuit consists of more than five points, and each point is controlled by a separate switch. I do not quite follow "Engineer's" arithmetic with regard to length of wire per point; personally, I make it 33 ft.

Your correspondent's remarks *re* obstacles encountered are unfortunate, as on this particular job it was necessary to pierce a wall in excess of 29 in. thick, and also another 15 in. wall. This being one of the first jobs, I was then woefully short of plant.

I hold no brief for Stannos wire or its makers, my original letter being intended more as a criticism of Mr. Beauchamp's figures. I am certainly of the opinion that the speakers at the recent Brighton Conference would do well to devote more attention to existing wiring systems, rather than strive after the unattainable system, which can be sent out ready made and fixed by the local handy man.

S. A. Hughes.

Cloughjordan, *July 24th*, 1911.

Private Electricity Supply.

I am seeking advice on the subject of the powers of a public lighting station and local authority, to prevent a private firm crossing streets with overhead wires (of course to comply with the Board of Trade requirements) for the supply of our other factories for driving and lighting.

We will call our factories A, B and C. A is the factory which we propose to use as a generating station, supplying B and C with current at 1,000 volts and transforming to our working voltage in each factory to suit conditions. There is enclosed a print with the factories A, B, C and all our own land and buildings lined round with red ink and red filled in. There is another point. We have to supply the machine owners or tenants in our factories with power for a fixed rental per week per machine. Can the public supply company prevent us from using electric drives instead of the existing steam drives, and, if we care, can we put meters in the shops of the tenants and charge them according to what they use, both for power and light?

A few particulars as to how we stand in this matter will be greatly appreciated.

Extension.

[This case appears to be covered by the Electric Lighting Act of 1909; in Clause 23 it is clearly stated that the Act does not prevent any company or person from supplying electricity to any other company or person, provided that the business of the former is not primarily that of supplying electrical energy. This condition is fulfilled, and therefore neither the supply company nor the local authority can interfere with our correspondent's arrangements.—EDS. E.R.]

Early Electric Lighting.

I note in your comments on my presidential address on page 82, the date of the original installation of six arcs in Madeira Road, Brighton, is given as 1891. This was a misprint, which I corrected in the first proof, but which the printers omitted to note. It should have been 1881, which was really three years before the South-Eastern (Brush) Electric Light and Power Co.'s experiment at Colchester, and it was even prior to the installation in St. Enoch's station, Glasgow; in fact, I have been given to understand on fairly good authority that the machines and lamps used in Brighton were transferred to Glasgow.

John Christie,
Engineer and Manager.

Electricity Works, Brighton,
July 21st, 1911.

Meters on Cars.

The tabulated summary of systems using car meters, prepared by Mr. Goodyer, does not mention the following:—Lanarkshire Tramways using 30, Manchester Corporation Tramways using 180, and Swansea Tramways using 16 time meters; and as this may lead to wrong conclusions as regards the use of time meters in this country, we shall feel obliged if you will kindly publish this information.

The "Acme" Meter Co.,
N. GUNN, *Manager.*

London, *July 20th*, 1911.

Battery Maintenance.

In a recent battery specification issued by a Corporation, alternative tenders were asked for maintenance in the ordinary way, and for a graduated scheme of payments. No particulars were given as to how the payments were to be graduated, but there is no doubt that the purchasers had in mind to pay a gradually increasing sum per annum; that is, to pay, perhaps, 2½ per cent. of the total ten years' payments in the first year, and increase the payments till they paid, perhaps, 25 per cent. or 30 per cent. in the last year. I remember two other public bodies having obtained tenders in this way. One of them was a very large municipality, and the battery was very small, the total maintenance for ten years being only about £40! In the other case the battery was a fairly large one. It seems to me a most reprehensible practice to maintain under such a scheme as this, as it necessarily means penalising the future ratepayers for the sake of the present ones.

J. S.

LEGAL.

THE FACTORY AND WORKSHOPS ACT.

THE Newcastle and District Electric Lighting Co., Ltd., were summoned at the Newcastle-on-Tyne Police Court on July 21st, on five charges of alleged neglect to observe certain regulations under the Factory and Workshops Act. The first information alleged that the defendant firm neglected to observe Regulation No. 14, in that at a switchboard in the said factory the bare conductors were not so placed as to prevent danger from accidental short circuit, and that, in consequence of such neglect, one William Middleton died. The second information was of a similar character, with the exception that it was alleged that the bare conductors were not so protected as to prevent danger, &c. The third information alleged neglect to observe Regulation No. 1, in that at a certain switchboard at the said factory the conductors were not so protected as to prevent danger so far as was reasonably practicable, and that in consequence of such neglect Thomas Cox suffered bodily injury. The fourth information was the same as the preceding, except that the man injured in this case was William Greenwood. The fifth, and last, information charged the company generally with failure to comply with Regulation No. 1, without alleging that such failure was the cause of death or injury to any individual. The counsel engaged were Mr. H. S. Mundahl for the prosecution (instructed by Mr. R. Sheriton Holmes, for the Director of Public Prosecutions); and Mr. E. Meynell, for the defence (instructed by Messrs. Leadbitter and Harvey).

MR. MEYNELL said he would plead guilty to one charge, and it was decided to go into the second charge, that which alleged neglect to protect the conductors, which resulted in the death of Mr. Middleton, the assistant superintendent of the power station in The Close, Newcastle-on-Tyne.

MR. MUNDAHL, in opening, said the case was taken under Sec. 136 of the Factory and Workshops Act, and they were there to consider the death of a man which arose from neglect to protect bare conductors so as to prevent danger from an accidental short circuit. On April 6th Mr. Middleton was killed in the performance of his duties at The Close Power Station, and it was necessary for the purpose of explaining the accident that the switchboard should be described. It was placed in a passage-way between two walls or partitions. Two bus-bars stood out from the switchboard about 10 in., and some distance from two copper brackets on the fifth panel of the switchboard was a screw. This screw was found to have got out of order on April 6th, and two men named Cox and Greenwood went to it to do some repairing. Apparently the spanner was not held straight, and in some way a contact was established between the positive bus-bar and the nut which was on the negative side; a slight flash occurred which resulted in the two men being injured. This must have led to a wave of current along the bus-bars to the two brackets, which were only 1 in. apart. Of course it was impossible to say exactly how the whole thing occurred, but it was surmised that the flash caused a great heat and fusion of the metal, which must have set up a deposit or film of metal between the copper faces of the two brackets, which allowed the current to flow over the short circuit. About an hour and a half later Mr. Middleton, the assistant superintendent, went to examine the sparking established at the point of the two brackets by this short circuit, and sent the man Cox to fetch a piece of wood, presumably to scrape away the film of metal. Before Cox returned he heard a loud report, and saw a flash, and running to the switchboard he found Mr. Middleton with his clothes on fire in front. There had apparently been a complete and extensive flash between the two faces of the metallic brackets, with the result that the edges were fused. As it required 2,000° F. to melt the copper, the heat must have been something in excess of that. It was not therefore surprising that Middleton was badly burned, or that the injuries combined with the shock had proved fatal.

MR. MEYNELL: He had a weak heart and died of shock.

MR. MUNDAHL: I do not think it matters, or has much bearing upon it. The man was undoubtedly killed. Proceeding, he said that was the position with regard to the accident, and the Home Office said that the regulations which were framed in the interests of the public ought to be carried out and every precaution taken. In this case, it was very obvious that precautions were not taken, because if the inch between the two brackets had been insulated, as it easily could have been with a piece of marble or slate, the accident could not have occurred.

MR. MEYNELL said that the switchboard had been entirely redesigned.

MR. MUNDAHL said the fact remained that after the accident the chief engineer at the works admitted that the switchboard was not safe for men to work at.

The chairman (MR. J. W. ROBSON) asked if the switchboard had to be examined or passed by anyone?

MR. MEYNELL said the local inspector had found no fault prior to this.

MR. MUNDAHL said it was not the duty of the factory inspector to be a superintendent engineer to every company he visited. It was the company's duty to take every precaution. He asked the Bench not to treat the offence as a technical affair, but to impose a substantial penalty so that it might be a warning to other companies to place their houses in order.

MR. MEYNELL submitted that the offence was a very trivial one, although the result had been very serious. The accident was one which no human being could have foreseen, and was of so extraordinary a character, that although Prof. Thornton had

examined the switchboard with a pressure of 14,000 volts—or 25 times the pressure it usually carried—he failed to obtain any of the results which had occurred on the day in question. The switchboard, which was made in 1907, was designed by one of the best firms of electrical engineers, and no one had ever suggested, either factory inspectors or the defendant company's own employés, that it was not safe. Until the accident happened, such an idea never entered the mind of anyone. He pointed out that whereas the company could have had the defects remedied for half a sovereign, they had spent £200 on a new switchboard, so that it was not a case of economy or a wilful breach of the regulations.

The CHAIRMAN of the Bench, after consideration, said if the precautions had been taken, as shown in the evidence at the inquest, the accident would not have occurred. The full penalty was £100, but having regard to the fact that the company's attention had not been specifically directed to the switchboard by the Board of Trade, and that the neglect was not wilful, they had decided that the penalty should be £50 and costs.

MR. MUNDAHL said that the charges based on informations Nos. 1 and 5 would be withdrawn, and he only asked for a nominal penalty in regard to the other cases.

MR. MEYNELL contended there was really only one offence, but left the matter to the justices.

Eventually a fine of 20s. and costs was imposed.

ISLINGTON ELECTRIC LIGHTING UNDERTAKING.

ON Friday last the Lord Chief Justice and Justices Lawrence and Avory, sitting in the King's Bench Divisional Court, heard an application by Mr. Cecil Walsh, on behalf of the London County Council, for a rule *nisi* for a mandamus directed to the Islington Borough Council calling upon them to show cause why they should not have five testing stations to their electric lighting undertaking in accordance with the County Council's electric lighting order. That order stipulated that an electric light undertaking should include five testing stations within such reasonable distance as the County Council should deem sufficient.

The LORD CHIEF JUSTICE: When did you apply to the Islington Council to carry out the order?

MR. WALSH: Notice was given in July, 1907. Since then they have been temporising.

His LORDSHIP: What was the result?

MR. WALSH: They have done nothing. Later, Mr. Walsh said the Islington Council said they had given careful consideration to the matter and come to the conclusion that they did not like the County Council's Act of Parliament.

The LORD CHIEF JUSTICE: You can have your rule.

ELECTRICITY IN SILICA WORKING.

(*Continued from page* 89.)

MR. BOUSFIELD, opening the defence, said the articles which the defendants sold to Messrs. J. and G. Cox, and of which the plaintiffs complained, were obtained from Beuel. That place had, however, ceased to manufacture such articles, and nothing the defendants now sold came from Beuel. As to the patent, the process claimed by plaintiffs had been gradually worked up by the efforts of a number of people helped by public money, who had co-operated to bring it up to the point at which it had arrived quite independently of any contributions which the plaintiffs had made. The view that defendants took was that the gas pressure in connection with the working of the silica had nothing whatever to do with it, except perhaps to some slight extent to modify the shape of the cavity. It was not a good specification of things material, and things immaterial were so mixed up that the vital conditions could not be elucidated. As regarded elucidation of conditions under which one was able to get the result which plaintiffs called initial separation—where was the information? Assuming that it was the gas which gave the result, he submitted that the specification of plaintiffs wholly failed, because it did not set out any of the necessary conditions to enable one to produce the result which plaintiffs said was vital. As a matter of fact, gas pressure played a very secondary part in the matter.

Evidence was then called. MR. OTTO DOLLMANN, secretary to the defendant company, said he had filled that position since January 10th. He remembered his firm selling silica goods to Messrs. J. and G. Cox, Ltd. Witness received the order for the goods about April 5th or 6th, which he passed on to Beuel on April 6th for execution. The goods were delivered on April 25th with the exception of a crucible.

Cross-examined: There was no explanation as to why the crucible was not sent in the first place. The defendant company was incorporated on November 18th, 1909. WITNESS denied that the company was formed with the object of selling goods acquired from Beuel. He could not say when they first commenced selling silica goods; it might have been the early part of last year. They were still selling such goods now.

And unless you are stopped, you intend to continue the sale?—Yes.

Is it a fact that, since you commenced the sale of these goods, you have continued to import silica goods, advertise them, and offer them for sale, and are doing so at the present time?—Yes.

How long did you continue to obtain a supply from Beuel?—We ceased all connection with them shortly after July, last year. I think about £2 6s. 11d. worth of goods has been purchased since the issue of the writ.

MR. SCHUEN, formerly technical director of the melting department of the works at Beuel, gave evidence as to the supply of silica goods from Beuel to the defendant company.

Cross-examined: The stock of silica tubes of plaintiffs' manufacture had been entirely used up before April, 1900. He could not say what price was paid for the tubes to the plaintiff company. He knew that an attack was made in Germany by the Beuel Co. on the Thermal Syndicate on the ground that the gas layer was a natural phenomenon and that the patent for blowing out could not be supported, because it was a natural phenomenon.

MR. FDK. WILHELM KUEHUE said he was technical director to some large electrical works in Zurich. He had been requested to make some experiments in connection with this action, which had been carried out after the English specification. The hollow in the centre of the silica tubes was produced by natural causes, and was not in any way due to gas pressure.

MR. JAMES SWINBURNE gave evidence as to the interpretation of plaintiffs' specification. He was of opinion that the sausage shape of the fused silica was determined by capillary attraction, and though the gas pressure might help, he thought it would take up the same shape without the pressure. There was no suggestion in the specification of inflating the tube by generating gas. Witness was cross-examined at great length on technical points, and also as to certain experiments with silica made by the plaintiffs.

Re-examined by MR. BOUSFIELD: The presence of gas under pressure in the actual condition of working did not affect the size of the hole inside the sausage of fused silica. He considered that gas pressure had nothing whatever to do with the size of the hole.

Evidence having been concluded, MR. COLEFAX addressed the Court on behalf of the defence. He pointed out that the plaintiffs had not attempted to offer any evidence at all as to whether they had endeavoured to make silica ware in a furnace, such as they now knew the articles in question were manufactured in. The whole of their experiments were made with their own furnace. They admitted that they had got particular conditions, but did not even attempt to put forward any evidence of their own as to what, in fact, happened if one were to work under different conditions in a furnace such as the furnace in which the infringing articles were made. The two furnaces were absolutely and entirely different. He would ask his Lordship to accept the evidence of fact as put forward by the defendants' witnesses. He submitted that not only did defendants not infringe, but the patent was bad on account of insufficiency, and also, in some respects, from want of utility. There was nothing before the Court on which his Lordship could find that defendants had in any way manufactured articles in accordance with the plaintiffs' specification. In fact, he failed altogether to see what case the plaintiffs really had against the defendants. Their case was based on a fallacy from start to finish. In order to establish that the defendants had infringed, plaintiffs must show that in the manufacture of the alleged infringing articles, the defendants enclosed the gas that was produced so as to facilitate the separation of the carbon core from the fused mass of silica. The evidence, as a matter of fact, clearly showed that, instead of retaining the gas, the defendants deliberately allowed it to escape.

MR. WALTER, K.C., replied at considerable length, and at the conclusion of the arguments his Lordship reserved judgment.

WEST HARTLEPOOL TRAMWAYS.

AN interesting question under the Tramways Act, 1870, was raised in the case of the Hartlepool Electric Tramways Co., Ltd., and Others, *v.* the West Hartlepool Corporation, which came before the Court of Appeal on Friday last, composed of Lords Justices Vaughan Williams, Fletcher Moulton and Buckley. The plaintiff company and Messrs. Sellon and Ashby, the promoters of a tramway undertaking in West Hartlepool, brought the action claiming specific performance by the West Hartlepool Corporation of an agreement to purchase the tramways. In other words, they claimed £12,963, the sum fixed by an arbitrator as the value of the undertaking.

It appeared that in 1905 a provisional order was obtained by Messrs. Sellon and Ashby, as promoters, for the construction of the tramways, which are known as the Park route and the Foggy Furze route. The order was confirmed by an Act passed in 1895, by which it was provided, *inter alia*, that the Corporation might purchase the undertaking after the lapse of 14 years. In August, 1896, before the tramways were constructed, the promoters entered into an agreement with the British Electric Traction (Pioneer) Co., Ltd., to sell the undertaking to them; and by a further agreement made in October, 1896, the undertaking was purported to be sold to the plaintiff company. Neither of the agreements was sanctioned by the Board of Trade, as provided by a section to that effect in the Confirmation Act. The construction of tramways, which was commenced in March, 1897, was duly completed. In January, 1910, the Corporation gave notice to the promoters, requiring them to sell their undertaking, knowing, as it was said, that the sale to the plaintiff company had not been approved by the Board of Trade. The matter was referred to an arbitrator, who assessed the value at £12,963. The Corporation, however, contended that they could make no valid payment to the original promoters who now had no legal title to the tramways; and that they could not pay anything to the plaintiff company, inasmuch as the assignment had not been approved by the Board of Trade. The plaintiffs accordingly brought the present action.

MR. JUSTICE BRAY gave judgment for the plaintiffs, holding that the original promoters were the owners of the undertaking, and that inasmuch as the Corporation had exercised their option to purchase, with notice that the transfer to the company had not been approved by the Board of Trade, they could not now be heard to say that the promoters were not the legal owners. The Corporation now appealed.

MR. BALFOUR BROWNE, K.C., in support of the appeal, said that his submission was that, inasmuch as the tramways were not constructed by the promoters, but by a company which had no

authority either to construct or to work them, the provisions of Sec. 43 of the Tramways Act of 1870 had not been complied with, and, therefore, neither the promoters nor the company had any legal ownership in or title to the undertaking. In those circumstances, it would be *ultra vires* of the Corporation to purchase the tramways.

LORD JUSTICE MOULTON: Is it your case that the Corporation ought to get these tramways for nothing?

MR. BALFOUR BROWNE: No, my Lord; my point is that we cannot acquire a title, and are, therefore, not entitled to purchase.

LORD JUSTICE BUCKLEY: You want to get out of your bargain?

MR. BALFOUR BROWNE: We want the company to get out of the streets, because, as we say, they are trespassers.

LORD JUSTICE MOULTON: Then the tramways fall to you, as the highways authority.

MR. BALFOUR BROWNE: No, my Lord; the company can take their tramways—remove both lines and cars at once if they choose.

LORD JUSTICE VAUGHAN-WILLIAMS reminded counsel that he was appearing for a public body, whose duty it was to act reasonably in the public interest. Was it right, asked his Lordship, for the Corporation to rely upon mere legal technicalities?

MR. BALFOUR BROWNE replied that it was entirely because he was appearing for a public body, that he felt it necessary to press the point. The Corporation could only act according to statute, and if they purchased this undertaking when they had no right to do so, individual members of the Corporation would be liable to be surcharged, and in the end would have to pay the £12,900 out of their own pockets. If the company would apply for a provisional order, and thus clothe themselves with the right which they at present did not posssess, the Corporation were quite willing to pay for the undertaking.

LORD JUSTICE MOULTON: The Board of Trade, apparently, have not objected to the assignment to the tramway company.

MR. BALFOUR BROWNE: The Board of Trade have not given their sanction, and therefore the undertaking is not transferred to the company.

LORD JUSTICE MOULTON: Then it belongs to the promoters.

Following MR. BALFOUR BROWNE, K.C., for the appellants, MR. MCCARDIE argued that the Corporation were not bound to perform the agreement and purchase under the Act of 1870.

Replying to LORD JUSTICE MOULTON, COUNSEL said the Corporation did not want to take the tramway materials or rolling stock. They wanted the undertaking conveyed to them, but they did not want to have to take over the materials, rails, &c.

LORD JUSTICE MOULTON said that it was really scandalous to suggest that because the company had made some irregularity in the formal transfer to themselves, the Corporation should have power to take the undertaking and not pay anything for it.

MR. MCCARDIE replied that he was not there to argue points of municipal etiquette, and contended that the Corporation were not bound to take anything more than the statute compelled them to. The consent of the Board of Trade was never obtained to the transfer to the company, and the Corporation were entitled to insist on their right to have transferred to them only the powers to run tramcars.

MR. DANCKWERTS, K.C., for the plaintiffs, submitted that the consent of the Board of Trade was not necessary, but if it were, then in fact it had been obtained.

The Court intimating that they did not wish to hear Mr. Danckwerts further,

LORD JUSTICE VAUGHAN WILLIAMS, in giving judgment, said the case for the Corporation failed for two reasons. In the first place certain correspondence which passed between the Assistant Secretary of the Board of Trade and the company was only consistent with a recognition by the Board of Trade of the company being the transferees of this undertaking. Such letters could not have been written unless the Board of Trade intended to give their permission. Moreover, no written consent of any sort was necessary in respect of the powers given by the tramways order, and in as much as there was an assignment from the promoters to the tramways company, and that assignment required no written consent, the company became themselves the promoters by succession. This diplomatic action by which the Corporation desired only to purchase a portion and not the whole of the undertaking of the company therefore failed. He did not think that any great harm was done by the failure of the action, but rather that it would be in the public interest.

Lords Justices Buckley and Moulton concurred, and the appeal was accordingly dismissed, with costs.

CLAIM ON A GUARANTEE.

IN the Lord Mayor's Court on Monday, before the Recorder (Sir Forrest Fulton, K.C.), and a jury, a claim was made by E.M.F., Ltd., electrical manufacturers, of Ironmonger Lane, E.C., against Mr. Fred Spink, butcher, of Kenway Road, Earl's Court, to recover the sum of £21 8s. 9d., the price of goods sold and delivered to Mr. W. Barnes, electrical engineer, of 12, Kenway Road, Earl's Court. Mr. McCaskie appeared for the plaintiffs, while the defendant was represented by Mr. Liversedge.

For the plaintiffs, it was stated that, in the early part of last year, Mr. W. Barnes was anxious to open an electrical establishment at Kenway Road, and the defendant Spink was desirous of assisting him. A shop was opened, and the business carried on under the style of W. Barnes & Co. On January 24th of last year, the defendant and Barnes called upon the plaintiffs and the two selected goods to the value of £62 12s., and subsequently a further order amounting to £7 was received. Certain goods were sent to Kenway Road, and a cheque was received from Barnes for £25. The plaintiffs then informed Barnes they would not send him any more goods unless they received cash against delivery. On February 7th, 1910, it was alleged that the defendant, who was behind Barnes in the venture, wrote to the plaintiffs saying: 'Mr. Barnes has been to me with reference to goods ordered from you. Your representative most certainly told him in my presence that he might have the goods and pay within three months; also he would let him have plenty of material to show, and as he is anxious to open, if you will send him on the goods to-morrow, I will see your account is settled during the week. He has some money due, and is daily expecting it."

COUNSEL said that the defendant undertook to be responsible for goods delivered, if Mr. Barnes did not pay for them. In due course the plaintiffs delivered the whole of the goods comprised in the two orders, of the value of £69. Subsequently cheques were received in part payment of the goods from the defendant. There was still a balance due to the plaintiffs of £21 8s. 9d., which was now sued for. An action had been brought against Mr. Barnes for the amount, and judgment was obtained against him on November 4th last. When the plaintiffs went to levy execution they found that the goods they had delivered were included in a bill of sale which had been registered in favour of the defendant. In addition to being behind Mr. Barnes, the defendant also had the plaintiffs' goods.

The RECORDER held that the plaintiffs could not succeed against the defendant, and at his direction the jury returned a verdict for the defendant, for whom judgment was entered, with costs.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

ON Monday, July 24th, the case of The British Westinghouse Electric & Manufacturing Co. *v.* The Electrical Co., Ltd., came before Mr. Justice Swinfen Eady, in the Chancery Division. This was a patent action in which the plaintiffs had succeeded, and the defendants now applied that the judgment, as given out, should be varied. The judgment ordered the delivery up to the plaintiffs of the arc lamps or parts of lamps in their possession, and the defendants asked that they should have the option of, instead of delivering up, destroying the lamps in the presence of plaintiffs or their agents. It was urged on behalf of the defendants that where articles were made in infringement of a patent, the property in the article did not vest in the patentee, but remained in the person who had unlawfully infringed the patent.

His LORDSHIP said the Court had jurisdiction either to order the delivery up of infringing articles, or to order their destruction in the presence of the plaintiffs, so as to prevent them being used. He had, however, to consider what the order was that was made at the hearing. The plaintiffs asked for delivery up, and the whole order proceeded on the footing of delivery up, and the defendants did not then ask for the alternative that there should be a destruction of the lamps or parts of lamps. It was, in his opinion, too late to ask for relief of that sort, and the motion to vary the order failed accordingly.

CENTRAL LONDON RAILWAY *v.* LAND TAX COMMISSIONERS.

ON Monday, before the Master of the Rolls, Lord Justice Farwell and Lord Justice Kennedy, an appeal by the Central London Railway against a decision of Mr. Justice Swinfen Eady was heard, regarding the company's liability to pay land tax where the line lay under highways, and the tax had been redeemed on lands abutting on those highways, and where it lay under any lands the surface of which had been exonerated from the tax by redemption. According to the *Times* report, Mr. Justice Swinfen Eady held that land exonerated from land tax when in its normal condition was entirely exonerated, but not when at the date of its redemption it was not in its normal condition and special circumstances existed to modify the price of redemption. He also held that redemption of the tax on lands or houses abutting on a public street did not confer exoneration up to the middle line of such street. The plaintiffs appealed upon the last point, and the Court allowed the appeal by a majority.

DEFECTIVE ELECTRIC CLOCKS.

AT Westminster County Court on Monday last, a case was heard in which Miss M. Blackwood sued Messrs. John Walker, Ltd., for £41 2s. 6d. as damages for breach of contract in respect of a series of electric clocks which plaintiff presented to St. Columbia Church, Chelsea, last year. The defendants installed a master clock with three dials on the church tower, and several other dials inside the church, at a price of £118 13s. The clocks were guaranteed for 20 years, but soon began to behave in a very erratic manner, the dials registering different times, and eventually plaintiff called in Mr. Hope Jones to rectify matters. Since then the clocks had kept satisfactory time. Mr. Hope Jones charged £41 2s. 6d. for the work, and the plaintiff claimed this sum from the defendants. Judgment was given for the plaintiff for £25, with costs.

ELECTRIC FITTINGS DISPUTE.

IN the West London County Court, on Monday, before his Honour Sir W. Lucius Selfe, Messrs. Childs & Co., electricians, Westbourne Grove, Bayswater, sued W. Strongitharm, builder, 183, New King's Road, Fulham, for £3 9s. 6d.

MR. H. WATTS DOLLEN, for the plaintiffs, said the claim was for £2 balance of a contract price for fitting up the electric installa-

tion at Peterborough Mansions, 5s. balance of an account rendered for goods sold, and 11s. 3d. the price of goods delivered to the defendant for sale and subject to 10 per cent. discount; the total amount of the claim was £3 9s. 3d. Defendant counterclaimed £2 15s. for work done to repair defects in the plaintiffs' work.

His HONOUR gave judgment for the amount claimed, with costs, the amount to be reduced by the value of the articles scheduled if returned to the plaintiffs in 14 days; and on the counterclaim for the defendant for 30s., with costs.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Bennis Stokers at Leeds.

The Leeds tramway system is one of the most important in the United Kingdom, and, contrary to the usual practice in this country, it operates its own power station, generating 16,342,280 units during the past year.

A feature of the boiler house is the range of 15 Lancashire boilers, all fitted with Bennis machine stokers and self-cleaning compressed-air furnaces. The stokers used are of the sprinkling type. These machines, by means of an ingenious device, feed the fuel at regular

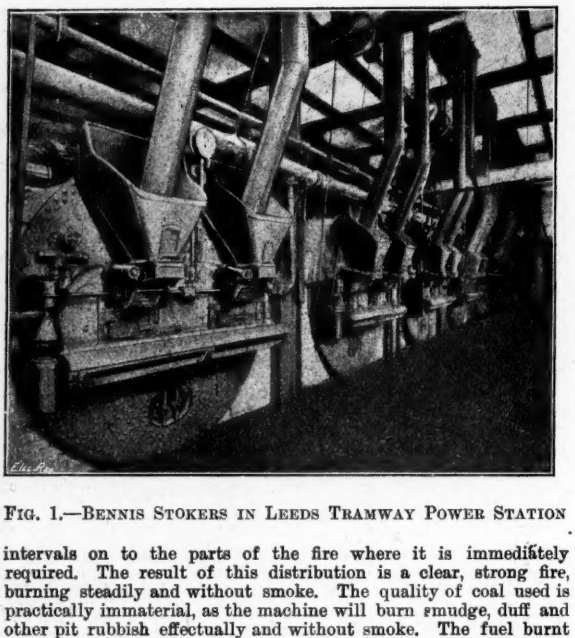

FIG. 1.—BENNIS STOKERS IN LEEDS TRAMWAY POWER STATION

intervals on to the parts of the fire where it is immediately required. The result of this distribution is a clear, strong fire, burning steadily and without smoke. The quality of coal used is practically immaterial, as the machine will burn smudge, duff and other pit rubbish effectually and without smoke. The fuel burnt at Leeds is "washed nuts," and the fuel cost per unit is ·23d. Our view shows the installation in the boiler house.

High Candle-Power Metal Lamp Fittings.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., of Tyssen Street, N.E., have recently issued a list (No. 84A) dealing with their 200-

FIG. 2.—SIEMENS "BRADFORD" LANTERN.

watt "Onewatt" drawn tungsten lamps, and drawing attention to the Bradford lantern a new type of lantern, suitable for the above lamp, and, in smaller and larger sizes, for the 100-watt bell or spherical lamps, and 1,000-watt lamps respectively.

This lantern is in zinc, with a special fluted clear globe and white enamel reflector, as shown in fig. 2. The same list covers the Sheffield lantern, with pear-shaped globe, half opal obscured diagonally, and suitable for one 200 or four 55-watt lamps. Messrs. Siemens are, of course, specialising in drawn-wire lamps, and their "Onewatt" series has recently been added to, by a 300-watt lamp, for voltages between 100 and 250. Full particulars of these drawn-wire lamps are given in list 4*a* 13.

Denny's Refillable Cartridge Fuse.

A novel form of refillable cartridge fuse has recently been devised by MR. C. W. DENNY, of 39, Oakley Crescent, Chelsea,

FIG. 3.—DENNY'S REFILLABLE CARTRIDGE FUSE.

illustrations of which we reproduce above. The unique feature of this fuse is that the refills, which are made up in paper or asbestos tube, are accurately calibrated and packed, making the operation of refilling as simple as possible, and also maintaining the maximum degree of accuracy. Refills for various capacities and voltages can be supplied neatly packed in cardboard boxes at a very small cost. The refills, which are practically paper cartridge fuses, are an easy fit into the outer fuse-case proper, and can also be made to fit porcelain handle type fuses.

E.A.C. Starting Panel.

THE ELECTRICAL APPARATUS CO., LTD., of Vauxhall Works South Lambeth Road, S.E., have sent us an illustration of their standard E.A.C. multiple solenoid panel, consisting of a number of

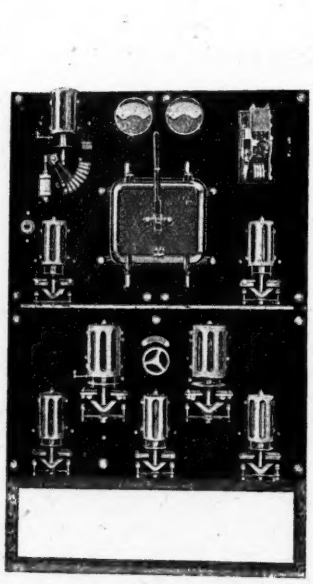

FIG. 4.—E.A.C. MULTIPLE SOLENOID PANEL.

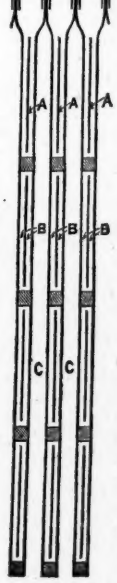

FIG. 5.—SECTION OF "USCO" AIR HEATER.

solenoid contactors, controlled by one master solenoid. An overload circuit-breaker is provided, besides a double-pole main switch and fuses, and an interlocked shunt regulator, all of which can readily be identified on the view, fig. 4.

The "Usco" Air Heater.

The "Usco" air heater, for recovering heat from the waste gases from boiler furnaces by heating the air supplied to the latter, has been described in our pages, and we need only mention here

that it consists of a nest of heating elements, each of which takes the form of a flat, semi-circular steel cell; these are fixed in the flues, so that the hot gases pass between the flat cells, while the fresh air passes through the interior of the latter and is thus heated. The UNDERFEED STOKER CO., LTD., of Coventry House, South Place, Finsbury, E.C., have increased the efficiency of the heating elements by fixing inside them flat plates, as shown in section in the accompanying figure. Radiant heat passes through transparent gases without raising their temperature, so that they can only be effectively heated by contact with hot surfaces. It will readily be seen that the "radiation plates" AA, receiving radiant heat from the outer walls of the cells CC, will become almost as hot as they, and being in contact with the air in the spaces BB, give up heat to the air and greatly increase the effectiveness of the heater. We understand that the use of these plates has been protected by letters patent in this country and abroad. A number of methods of utilising the heaters are illustrated in a pamphlet recently issued by the company.

BUSINESS NOTES.

Book Notices.—*Low-Voltage Electric Lighting with the Storage Battery*; and *Wiring Houses for the Electric Light*. By N. H. Schneider. London: E. & F. N. Spon, Ltd. Price 1s. 6d. net each.—The first of these books is intended to give practical information about the installation of electric light in isolated premises, on yachts, &c. The author explains in simple language the elementary facts about the electrical units and apparatus required for his purpose, and proceeds to describe various accumulators, fittings, &c., in somewhat haphazard fashion, giving specifications for installations of 6 and 10 lamps at 10 volts, and 10 and 14 lamps at 27½ volts. Some typical installations are described, with half-tone illustrations, and instructions for running the plant are given.

The second book gives a detailed account of house-wiring for a pressure of 110 volts, though the author is more particularly concerned with low-voltage installations. The system adopted is mainly that of wiring through joists and on "knobs," and full directions are given, as well as for surface wiring with cleats and in casing. Unfortunately both books deal solely with American practice, which differs so much from British practice that they are not likely to be of much service to readers in this country.

Universal Directory of Railway Officials. 1911. London: The Directory Publishing Co., Ltd. Price 10s.—This directory is now in its 17th year, and will, no doubt, prove as useful a book of reference as it has certainly been in previous years. It is especially interesting to electrical men, because it includes practically all the electric tramways in the United Kingdom, as well as the electric railways. The "Personal Index" is a particularly useful feature of the work.

"The Physical Review." Vol. XXXII, No. 6. June, 1911. Lancaster, Pa.: Price 65c.

"Applied Electrochemistry." By M. de Kay Thompson. London: Macmillan & Co., Ltd. 1911. Price 9s. net.

"Building in London." By H. Cubitt. London: Constable and Co., Ltd. 1911. Price 31s. 6d. net.

Dissolution and Liquidation. — ALUMINIUM CORPORATION, LTD. (incorporated 1907, went into voluntary liquidation December 9th, 1908).—Creditors are required to forward particulars of claims before September 1st to R. Lawson, 60, London Wall, E.C., one of the liquidators. This notice does not apply to the Aluminium Corporation, Ltd., incorporated December 17th, 1909.

STANLEY & SIMPSON, Margate, electricians.—The partnership between C. W. Stanley and J. W. Simpson has been dissolved by mutual consent, as from March 31st, 1911. The business will be carried on by J. W. Simpson.

Bankruptcy Proceedings. — CUTHBERT FENTON LINDOP, electrician, 62, Dale Street, Liverpool.—The first meeting of creditors herein was held last week at the Official Receiver's offices, 35, Victoria Street, Liverpool, Mr. Britten, the Assistant Official Receiver, presiding. The statement of affairs showed unsecured liabilities amounting to £900 11s., and no assets. The debtor attributed his failure to loss on contracts, insufficient trade, and losses on working a patent electrical sign. The receiving order was made on a creditor's petition, the act of bankruptcy being the execution by the debtor of an assignment of his property in June last to a trustee for the benefit of his creditors generally. It was stated that the debtor in October, 1909, commenced business as an electrical engineer under the style of C. F. Lindop & Co., at 62, Dale Street, Liverpool, with a capital of £200, which he had borrowed for the purpose of exploiting an electrical patent advertising sign of his own, which seems to have proved a failure. A company called C. F. Lindop & Co., Ltd., was registered on March 18th, 1910, and on April 26th a debenture was issued by the company for £100, of which the debtor received £73, the balance being applied in payment of costs of registering the company. The debtor stated that he signed two agreements for the sale of his assets to the company. A debenture-holders' action was commenced against the company shortly before the receiving order, and on the 3rd inst., the Vice-Chancellor of the Lancashire Palatine Chancery Court appointed a Receiver of the assets on behalf of the debenture-holders. The only book of account kept was a rough day-book. The whole circumstances attendant upon the creation and formation of the company and the issue of the debenture were unsatisfactory, and called for the closest investigation. No resolutions were passed, and the matter remains in the hands of the Official Receiver.

CHARLES HELLYER PEARSON (Pearson & Co., and the B.O.A. Engineering Co.) Manchester.—Notice of dividend is given in the *London Gazette*; last day for receiving proofs, August 4th, 1911. Trustee, A. Yearsley, 27, Brazennose Street, Manchester.

ALPHONSE C. A. WAMPACH, Hythe.—Notice is given in the *Gazette* of first and final dividend of 8½d. in the £; Official Receiver's office, Canterbury.

W. H. RIDPATH (Ridpath & Wells), Ilkeston.—The first meeting will be held on July 31st, and the public examination on August 2nd, at Derby.

E. RISTORI, Westminster.—Adjudication in the High Court of Justice in Bankruptcy, July 19th, 1911.

J. G. CHILDS & CO., LTD., Hawthorne Road, Willesden Green, N.W.—First meeting of creditors, August 1st, at Carey Street. Proofs to Official Receiver by noon, July 31st.

GEORGE MONTAGUE SELLICK, manufacturer of electrical accessories, Forest Gate, Essex.—An order was made on June 27th for discharge as from June 27th, 1913.

Annual Holidays.—THE BRITISH PROMETHEUS CO., LTD.—Offices and works will close on Wednesday, August 2nd, and re-open on Monday, August 14th. A small staff will be in attendance to deal with urgent matters.

BRITISH INSULATED AND HELSBY CABLES, LTD.—The Prescot Works will be closed from noon, Saturday, August 5th, to 8 a.m., Monday, August 14th, for the purpose of the annual overhaul. The offices at Prescot will be closed only from Saturday noon, August 5th, to Wednesday morning, August 9th.

A. SEAGE & CO., London, W.—The works and offices will be closed from noon, Saturday, August 5th, until Monday, August 14th.

POPE'S ELECTRIC LAMP CO., LTD., Hythe Road, Willesden, N.W.—The works will be closed from August 7th to 12th.

MESSRS. MAWDSLEY'S, LTD., Zone Works, Dursley.—The works will be closed from Friday night, the 4th prox., until Wednesday morning, the 9th.

MESSRS. E. BROOK, LTD., Colne Road, Huddersfield.—The works will be closed from Friday, August 4th, until Monday, August 14th.

THE ELECTRIC & ORDNANCE ACCESSORIES CO., LTD., Aston.—The works and offices will be closed from Friday evening, August 4th, until Monday morning, August 14th.

Trade Announcements.—THE BENJAMIN ELECTRIC, LTD., inform us that the telephone number at their new offices and showrooms at 117, Victoria Street, Westminster, is No. 1297 Victoria.

WALSALL ELECTRICAL CO., LTD., 57, Bridge Street, Walsall, have appointed as their London agent Mr. S. H. Fielden, of 90, Charing Cross Road, London, to whom they wish readers to send all inquiries.

MR. STANLEY HARVEY DOUGLAS has taken over the business of Messrs. Price & Co., electrical engineers, of 16, High Street, Newport (I. of W.).

MESSRS. TETLEY & CO., of Falcon Electrical Works, Bedford Street, Greengate, Salford, inform us that they have given up their London agents, and, pending further arrangements, wish all orders and inquiries to be addressed direct to the works, so that they may receive prompt attention.

Lea Recorders.—Orders have recently been received for these recorders from the Dublin United Tramways Co., Stretford, Dublin, Aberdeen, East Ham, Sheffield, Torquay, Cape Town, Walthamstow, Walsall, Eastbourne, Burnley and Blackburn Electricity Works, City and South London Railway, Midland Electric Corporation, County of London Electricity Supply Co., and Melbourne Electric Supply Co., Ltd.

For Sale.—MESSRS. P. HUDDLESTON & CO. will, on Tuesday, August 1st, sell by auction a large quantity of electrical apparatus at 16, Long Millgate, Manchester. See our advertisement pages to-day.

Fire at Taunton.—MESSRS. NEWTONS, LTD., electrical engineers, Taunton, inform us that the fire which occurred in their main foundry on the 19th inst. has done no serious damage, and they are able to give their usual quick deliveries, the damage having been promptly repaired.

Catalogues and Lists.—MESSRS. CROFT & PERKINS, LTD., Thornbury, Bradford.—Catalogue of power-transmitting machinery and appliances, which, it is claimed, is the most complete compilation of up-to-date mill-gearing practice ever issued. It is a substantial volume, divided into 15 sections, with thumb indexes. The respective sections deal with shafting and couplings, plummer blocks and brackets of several types, belt driving (pulleys, guides, tighteners, &c.), rope driving, gear wheels, clutches, speed changes, belts and ropes, and a variety of accessory and special devices incidental to the use of the foregoing apparatus. The book, however, is by no means only a catalogue; it is a technical work of high order, containing a great store of information on every department of mechanical power transmission, numerous tables of technical data, and, in Section XV, rules, tables and formulæ covering a wide range of applications. Some electrical

data are given, and flexible insulating couplings are included. Altogether, the "catalogue" is quite an encyclopædia of knowledge on the subject of power-transmitting machinery.

The Piggott Electrical Co., 24, New Bridge Street, E.C.—Price list of cables and wires, and china cable connectors.

The Union Electric Co., Ltd., Park Street, Southwark, S.E.—Price list of "Crane-rated" motors for driving cranes, lifts, winches, hoists, &c., including both D.C. and A.C. (three-phase) machines, open protected, enclosed ventilated, and totally enclosed, of which very complete data are given. The sizes range from ¼ to 40 B.H.P., D.C., and from 1¾ to 65 B.H.P., A.C.

The Corona Lamp Works Co., Ascham Street (St. Pancras), London, N.W.—Price list of the "Corona" new patent tungsten lamps with double frame cross filaments, as devised by Mr. S. Horvath, whose business is incorporated with this company. All the usual sizes and voltages are listed—up to 1,080 C.P., as well as "Metaflect" and other special types, and they are all British made.

Messrs. Siemens Bros. & Co., Ltd., Caxton House, S.W.—Leaflet recording long motor-cycling runs which have taken place recently, in which a Siemens-Obach ignition dry battery, without reserve, was used by Mr. H. Karslake over distances aggregating more than 764 miles, without failure. A similar battery was used for a run of 762 miles, from London to Edinburgh and back.

National Electric Lamp Association (Engineering Department), 4,411, Hough Avenue, Cleveland, Ohio, U.S.A.—Bulletins Nos. 16 and 17, relating to "Mazda" incandescent street lighting, and the economical operation of incandescent lamps.

The Weston Electrical Instrument Co., Audrey House, Ely Place, Holborn, E.C.—Folder giving illustrations of eight different types of switchboard A.C. indicating instruments, with some brief particulars regarding them.

F. Hodgson & Co., 24, Queen Victoria Street, E.C.—Leaflet relating to the "A P" electric fan.

Messrs. Wilson Hartnell & Co., Ltd., Volt Works, Leeds.—Catalogue (Section IV) of governors and governor gear. The Hartnell governor, first patented in 1876, has ever since been a household word in steam practice, and is still the firm's standard type of vertical governor, lending itself to the control of trip-gears and link-gear expansion valves; in addition, various modifications of the governor are listed with full particulars, and some useful technical notes, based upon the unique experience of the firm, are embodied in an introductory section, which greatly add to the usefulness of the catalogue.

Scottish Tube Combine.—It is reported that practically all the Scottish firms making wrought-iron and steel tube have joined in the formation of a company, to be known as the Scottish Tube Co., Ltd., with a capital of £600,000. Messrs. Stewarts and Lloyds, the largest producers, are not included, but will work in harmony with the company, in which they will hold shares. The object of the combination is to put an end to the ruinous price-cutting which has prevailed since the disruption of the International Tube Trade Association four years ago.

LIGHTING and POWER NOTES.

Argentina.—The Sociedad Empresea de Luz y Fuerza, of Buenos Ayres, which owns the central electricity station in the town of Mendoza, is about to considerably extend the same; it is also in negotiation with reference to the construction and working of an electric tramway in the town.

Baildon (Yorks.).—The District Council of Baildon, a very popular and growing residential area near Bradford, had reported to it on Tuesday last week, the fact that the Wharfedale Electric Light and Power Syndicate is about to apply for an order to enable it to supply electricity in the Baildon district. The syndicate asked the council to consider the purchase of electricity in bulk from the company. The Council, however, which appears to have a rooted dislike to outside companies gaining a monopoly in any branch of public supply in the district, decided very emphatically to maintain its position in that direction and to withhold its support and oppose the granting of the order.

Barking.—The price of energy for cooking purposes is to be reduced to 1½d. per unit. The Council has decided to retain the services of Messrs. Hammond & Son, consulting engineers, at an inclusive fee of 50 guineas, to report upon a scheme of extensions to the electricity works.

Barnstaple.—At the instance of the T.C., the B. of T. has deleted from the Barnstaple Gas Order the words, "or a supply of electricity."

Belfast.—At the fortnightly meeting of the Tramways and Electrical Committee on Monday, the electrical engineer reported on the tenders for a circulating pump and motor-driven air pump, and those of the Rees Roturbo Manufacturing Co., Wolverhampton, and the Worthington Pump Co., respectively, were accepted. It was decided to make application to the L.G.B. for sanction for a loan of £40,000 for the purpose of carrying out the proposed extensions to the cables, &c. The necessity for extending the generating station was also discussed, and a Sub-Committee was appointed to consider the matter and report.

Bingley.—The U.D.C. has adjourned the question of consenting to an application for a prov. order for electric supply by the Electrical Distribution of Yorkshire, Ltd., pending inquiries as to whether it is possible to get a supply of current from Bradford, Shipley or Keighley.

Bootle.—The annual report of Mr. T. D. Clothier (Borough electrical engineer) on the electrical undertaking shows that a record surplus was obtained in the year ended March 31st, 1911. There is every indication, he points out, that the setback to the output due to the introduction of the metal-filament lamps has now disappeared, and with the increased output during the year there has been an increase in the maximum demand upon the works, which last winter reached the limit for which the plant should be relied upon. The number of customers was 755. There were users of electricity having motors equal to 2,533 H.P., receiving a supply from the undertaking, but there were users of over 9,000 H.P. being served by steam and gas engines, and most of those users might wish to change as their present arrangements got older. Little progress had been made in the use of electricity for heating and domestic purposes, and it was unlikely that any considerable development would take place until the price for these purposes had been reduced. In regard to the Corporation trading in the supply of fittings, wiring, motors, and the installing of apparatus, for which it possesses powers, the Electricity Committee has been trying as an experiment a scheme whereby metal-filament lamps of suitable candle-power are supplied and maintained for a payment of 20 per cent. on the amount due for current consumption, except as against mechanical breakages.

Reporting upon the plant, the engineer states that the units sold work out at an average of 1,480 for each electrical H.P. of plant; 1,000 units is a good average figure, being the exact output, for instance, in the case of the Liverpool supply. With regard to the financial position of the undertaking, the percentage of gross profit was 8·83 per cent. of the total expenditure; it was, however, 13·6 per cent. when compared with the capital at present represented. The capital outstanding reached a maximum figure in 1905 of £99,192, since which time it had steadily declined to £74,254. The entire revenue only amounted to 17·8 per cent. of the capital expenditure, so that careful management was required to leave any surplus.

Brazil.—A decision, which will become law when passed by the Brazilian Parliament after the third reading (the second reading having been passed), grants permission to the Compagnie Brésilienne d'Energie Electrique or any other company or private individual who may apply for it, to lay down, work, and use a system of transmission of electric power for private lighting in Rio de Janeiro and its suburbs. This concession will have a duration of 60 years. The holders of the concession undertake to:—(*a*) Accept such clauses as the Government may impose for the public safety and the regularity of the service; (*b*) Not to charge more than 100 reis-paper per KW.-hour consumed for lighting; (*c*) To inaugurate the service on September 16th, 1915. The present concession grants no monopoly, the Government reserving the right to grant same in open competition. All decisions contrary to this are abrogated. The Rio de Janeiro Municipality has signed a contract with the above company.

Bridlington.—On the 21st inst., the Mayoress switched on the new electrical illuminations introduced on the Royal Princes Parade at Bridlington, the property of the T.C., and she was presented with a mounted and inscribed silver switch by the Property Committee

Bristol.—The annual report of the engineer and general manager of the electricity undertaking (Mr. H. Faraday Proctor) states that the number of additional consumers connected during the 12 months exceeded that of any of the past six years, and the increase in the power connections was again highly satisfactory, being nearly twice as great as the increase in the previous year. The use of metallic-filament lamps is still operating to the advantage of the consumer, as evidence of which the following particulars of revenue from lighting supply during the past four years are given: 1908, £47,447; 1909, £43,416; 1910, £40,779; 1911, £41,543. Thus, although the amount of actual light supplied to consumers for the past year has been enormously greater than that supplied in 1908, the consumption required to produce this increased amount of light has diminished to the extent that consumers have paid in the aggregate £6,000 less. There has again been a substantial decrease in the total costs of production for the year which work out at ·887d. per unit sold, as compared with 1·002d. in 1910, a net reduction of over 11 per cent. The gross profit has increased over that of last year to the extent of £5,612. The accounts show that the gross receipts amounted to £84,434 and the gross expenditure to £36,001, leaving a gross profit of £48,433. After deducting interest on loans, &c., and also putting aside £3,042 for renewals there is a deficiency of £768 in the revenue account which is to be met from the unappropriated balance in hand which stands at £4,041.

Bury.—At the forthcoming Lancashire Agricultural Show to be held at Bury, there will be a representative exhibition of electrical apparatus by the Corporation Electricity Department.

Cardigan.—The T.C. has informed a resident who desires a supply of electricity, that it is not the intention of the Corporation as such to embark upon an E.L. scheme, but that it was open for anyone to do so.

Clitheroe.—At a meeting of the T.C. on July 20th, a letter was read enclosing notice under the Electric Lighting Act, 1882, by Mr. James Speight, that he intended, on behalf of a pro-

posed company, to apply for a provisional order for the supply of electricity within the borough.

Continental Notes.—AUSTRIA.—A syndicate of Swiss capitalists in conjunction with the municipal authorities of Pettau, contemplates erecting a large power station on the River Drau between Pettau and Friedau. Power to the extent of 34,000 H.P., to be eventually increased to 54,000, will be generated. The Siemens-Schuckert Werke and the Elektricitäts Gesellschaft Ganz, of Budapesth, are associated in the project.

Although Innsbruck, the capital of the Tyrol, already possesses two large electrical works (one in the Mühlan Valley and the other in the Sill Valleys), with a total output of 21,000 KW., it has become needful as a result of the constant increase in the consumption of power for industries and tramways to erect a third station. According to statements made at a municipal meeting several schemes have been considered, that for the utilisation of the Achen Lake being the most favourably regarded. Its realisation, it is estimated, will cost upwards of 4½ million gulden. Pending the raising of the necessary capital and the completion of the technical details, the Council has decided to set up a temporary steam installation of a maximum capacity of 3,000 H.P. The funds for the purpose have already been voted. The permanent scheme is expected to be actively taken in hand at the beginning of next year.

FRANCE.—A company has just been formed at Beaumont, with a capital of £11,200 and the title La Société d'Energie Electrique de Chauffailles, La Clayette et Extensions, to acquire and carry on a small electricity generating station near Beaumont (Saone-et-Loire) and the concessions for the electric lighting of the little towns of La Clayette, Chapelle-sur-Dur, and Chauffailles.

Derby.—The T.C. has reduced the price of energy for the tramways from 1·5d. to 1·45d. per unit.

Edinburgh.—The Corporation Electric Lighting Committee recommends the T.C. to give from the surplus (which amounted, for the the year ending May last, to about £8,000) on the electric lighting account such sum as may be required to meet the deficit on the building fund account of the College of Art. Under the Electric Light Order Confirmation Act, 1891, the Corporation has power to apply such surplus to the improvement of the district, and it is in virtue of this clause that the Committee has made the recommendation. If the whole surplus were handed over, together with the other contributions expected, the total cost of the building would be met.

Thanks to the co-operation of the Citizens' Committee and the Corporation Electric Lighting Department, the latter supplying the current free of charge, the illuminations on the occasion of the Royal Visit were on a brilliant scale. At the west end of Princes Street the triumphal arch and the circle of Roman Columns were decked out with thousands of electric lamps and the spectacle was a magnificent one. The triumphal arch at the east end of Princes Street was also illuminated, but perhaps the most charming in its artistic effect was the Nelson monument on the Calton Hill on which a searchlight was placed.

Egham.—Mr. A. P. Trotter, of the B. of T., attended last week for the purpose of hearing objections to the proposal of the Egham District Electric Light Co. to erect a generating station upon land adjoining the gasworks at the Causeway. The Inspector said at the outset that it was not a question of finding a site free from all objection, but one where objections were at a minimum.—On behalf of the company, Mr. Dykes said it was proposed to put up a station containing two Diesel oil engines of about 110 to 120 H.P. each. His firm had installed them in other residential districts, and there had been no complaints. The proposed building would be an ornament to the district. To meet the wishes of the Thames Conservancy, the company had agreed to plant trees on the riverside boundary, and the Conservancy were not objecting to the proposals.—Mr. Hutchins, for the objectors, urged that the proposal was prejudicing intending tenants of adjoining property, and if it were sanctioned the company's engineers would be the judges as to the engines. The adjoining owners would have very little opportunity of protesting after the present inquiry.—Mr. Dykes said two years ago similar engines were installed in Messrs. Peter Robinson's premises in Oxford Street, just under their showrooms, and that they could not be heard in the rooms above.—The Inspector stated he could confirm this, having visited the premises mentioned. In conclusion, Mr. Trotter said the objections which had been made were very reasonable and very well expressed, and he hoped that when the works were erected it would be found that the objections were not well founded. He would report in due course to the B. of T.

Fleetwood.—The electricity undertaking has made a profit for the past year of £1,207. Of this amount, £807 is being placed to reserve; the remaining £400 is to defray the expenses in connection with the Coronation festivities. Owing to the successful year's working the Council has been enabled to make a substantial reduction in the scale of charges. It is anticipated that with careful management the undertaking will prove a profitable asset to the town and one which will thoroughly justify the Council's action in purchasing the business.

Haslingden.—The Education Committee has forwarded to the Director of Education for the County, the scheme and estimate in connection with the proposals for the electric lighting of the old and new portions of the secondary schools.

The L.G.B. has sanctioned the borrowing of £8,188 for purposes of electric lighting as follows:—£6,238 for mains, including £1,000 for future extensions (25 years); £850 for sub-station equipment (15 years); £350 for services (15 years); £250 for meters (5 years); £500 for the purchase of motors for hire (10 years).

Japan.—The Tamagawa Electric Railway Co. is now supplying electrical energy for lighting purposes to Adyama, Shibuya, and other suburban districts of Tokio.

Killeshandra (County Cavan).—The L.G.B. has authorised Dr. B. Macarthy, one of its inspectors, to hold an inquiry into the application of the Cavan R.D.C. for powers to act as an urban authority for the purpose of carrying out an electric lighting scheme for the town.

Llandudno.—Following a reduction a month ago in the price of gas, a proposal was submitted to the U.D.C. on July 21st, by the Electricity Committee, that the price of electricity to householders and other consumers who pay on the flat rate, should be reduced from 5d. to 4½d. per unit. It was shown that the profit from the concern last year was £838 less than that of the previous year, but this was mainly explained by extraordinary expenditure on renewals, new installations, &c. The proposed reduction created much discussion, some members contending that the concession would lead to financial difficulty. Eventually the reduction of ½d. per unit was approved on the chairman's casting vote.

London.—ST. PANCRAS.—The borough treasurer reports that the gross income of the electricity undertaking for the year ending March 31st last amounted to £81,368, an increase of £4,396 over the previous year, and £6,010 over the income for the year ending March, 1909. The net profit was £13,203, which showed an increase of £3,696 over the preceding year and £6,076 over the year before. The net balance to the credit of the reserve fund is £40,547. In regard to the disposal of this year's profit of £13,203, £3,161 is to be written off the capital account of the electricity undertaking in respect of the small engines at the Regent's Park generating station, and £4,000 is to be added to the balance of the net revenue account to avoid the necessity of an overdraft of the current account at the bank. Mains are to be extended and rearranged by the chief electrical engineer at an estimated cost of £3,000. Application is to be made to the L.C.C. for sanction to borrow £10,314. This amount includes the following sums for the estimated expenditure to March 31st, 1912: Mains, £3,324; services and switches, £1,040; meters, £500.

STEPNEY.—The Works Committee has received a letter from the Electricity Committee upon the subject of the charge for steam supplied from the dust destructor. The letter states that in the opinion of the Electricity Committee the present charge of ·4d. paid to the Works Department for each unit distributed on destructor steam should be reconsidered, and suggesting that the charge as from, and including, the financial year should be not more than ·23d. per unit, which represented the Committee's works costs, and in this connection to guarantee to take 1½ million units per annum, subject to the Works Committee agreeing to maintain a steam pressure of 180 lb. and supplying sufficient steam to enable two engines to be run on such steam.

MARYLEBONE.—At present the rate for contractors' showrooms is 2d. per unit, and providing a reasonable amount of heating, cooking and apparatus other than lighting is displayed, it is to be reduced to 1d. per unit. In the event of any difficulty being experienced in contractors obtaining the necessary apparatus to exhibit, this will be surmounted by the department supplying apparatus on loan. The Electricity Committee has approved the following suggestions of the general manager which affect wiring contractors, viz., hire of wiring and inclusive charges per quarter for rent of installation, maintenance and current. As regards this an agreement for three years is required, by which time the cost of wiring is repaid by the consumer, and it becomes his property. It is proposed to sublet this kind of wiring entirely to contractors, and to arrange for one in each district representative's area to do the work. If this arrangement works satisfactorily it will no doubt be extended. The second suggestion is with regard to the loan of apparatus on trial, and in this respect the Council is in a better position than contractors, owing to the fact that it possesses special facilities. It is proposed to offer contractors any apparatus which their customers desire to try, on the same conditions as the Council's representatives loan such apparatus to consumers, and if the contractors' customer purchases the apparatus the department will sell it to him at trade price. According to a certificate from Messrs. Price, Waterhouse & Co., chartered accountants, the bonus payable to the general manager and chief officers of the department, pursuant to the resolution of the Council of July 14th, 1910, amounts to £788, in respect of the audited accounts for the year ended March 31st last. This amount is subject to a deduction of 2 per cent. under the Superannuation Act, leaving a net payment of £772. The payment of this bonus was subject to two conditions, viz.: (1) The sales of the electrical energy were to exceed those of the previous year by 500,000 units (the actual increase, as will be seen from the annual report, was 1,560,497 units); and (2) the average price charged for both private and public supplies was to be diminished by not less than 5 per cent. on the previous year's average (the actual decrease was ·387d. per unit or 10·73 per cent.). The present alternative methods and rates of charge for the supply to consumers are to be continued until June, 1912.

HAMMERSMITH.—The Electricity Committee recommends that a sum of £300 be set aside for the current year from the revenue of the electricity undertaking for the purposes of general advertising, this amount to include the salary (£156) of the present canvasser, and to be spent from time to time as the Committee may consider most desirable. The Committee is apparently waking up, but as the amount voted is not 1 per cent. of the revenue of the undertaking, there is evidently considerable further scope for activity.

Maidstone.—The T.C. has applied to the B. of T. for permission to supply current to the pumping station of Messrs. Balston, which is outside the borough.

Meltham.—The old dining hall at the mills of Messrs. J. Brook & Bros., sewing thread manufacturers, is being converted into a power station for the installation of power plant.

Milnrow.—The Rochdale T.C. has asked the U.D.C. to consent to the Corporation supplying current to a cotton-spinning shed proposed to be erected at Newhey. The Council has referred the matter to a committee for consideration.

Norwich.—The Electricity Committee of the T.C. reports that during the year ending March 31st there was an increase of 704,000 units in the output, or 17 per cent., as compared with 1909-10. The increase in the lighting was 9 per cent., and in power 26 per cent. The production, given in precise figures, was 4,817,412 units, as compared with 4,113,197 units. The income showed an increase of £4,097, while the expenditure increased £4,340. After provision for interest and sinking fund (£15,122), a balance of £5,744 remained for transfer to the appropriation account. It was not proposed to apply any part of this balance in reduction of rates, but £8,841 was now available for further expenditure on public lighting, &c. It was proposed out of this sum to provide a new battery of accumulators, which, with additions to buildings and special machinery, would absorb £5,100. The cost of production per unit last year was 0·913d., as compared with 0·943d. The total length of distributing mains was now 49 miles; it had been found necessary to lay some trunk mains at a cost of £2,338, which had been paid out of revenue.

The Electricity Committee is engaged in converting about one-third of the city street lamps for electric lighting, at a cost of £5,000. The other two-thirds will be similarly dealt with in the next two years, the expenditure being met out of revenue, and it is expected that at least £1,000 a year will be saved by the change.

Oldham.—The Electricity Committee of the T.C. on July 19th decided to discontinue the practice of supplying motors on hire to consumers, if the traders of the town will take up the business. This is the outcome of representations by the electrical section of the Chamber of Trade, who contended that in hiring out motors the Committee is infringing not only moral rights, but statute laws. On the other hand, the Committee has pointed out that the local traders have refused to let motors on hire, and compelled the electricity department to meet the demand.

Oswaldtwistle.—A conference between the Gasworks and Lighting Committees is to be held to consider the best system of lighting the highways.

Pwllheli.—A scheme for the laying down of plant to provide the town with electric light is contemplated.

Rawtenstall.—The T.C. has received a letter from the L.G.B., sanctioning the borrowing by the Corporation of a further sum of £15,650 for the purpose of the electricity undertaking.

Runcorn.—The Mersey Electric Power Co. proposes to apply to the B. of T. for sanction to the running of overhead wires in certain parts of the R.D.C.'s district. The Council has given its consent to the application.

Selby.—The U.D.C. has decided to inform the firm which has given notice of its intention to apply to Parliament for a provisional electric lighting order for Selby, that it will oppose the same.

South Africa.—Some discussion has taken place in the financial papers on a report that several Johannesburg mines where electric power has been introduced, had decided to recommission their steam engines. The natural explanation given is that the Power Co. has been unable to keep pace with the demands made upon it; in any case, the mines have contracted to use electricity for a long period of years only after careful investigation. That they have not been misled can be gathered from the chairman's statement at the New Gooch meeting, that the saving effected by the use of purchased electrical power was equal to 7·28d. per ton milled. The Roodepoort United plant, excepting hauling engines and compressors, is entirely driven by purchased electrical power, and the total cost of power for the whole reduction process, from the headgear bin to the residue dumps is given as 8·8d. per ton, including the cost of mine pumping. The compressed air plant of the Rand Mines Power Supply Co. is not yet completed sufficiently to supply the demands of the Rand Mines, Ltd., but the 4,000 H.P. compressors already installed are reported to be quite satisfactory.

Stockton-on-Tees.—The T.C. has adopted the following revised scale for current for power: Below 150 units per quarter, 2d. per unit; 150 units to 500, 1½d.; 500 to 5,000, 1½d.; 5,000 to 20,000, 1½d.; beyond, 1d.

Stourbridge.—The Stourbridge and Halesowen Hospital Committee has decided to procure an estimate for lighting the hospital by electricity.

Swansea.—The Chairman and Vice-Chairman of the Tramways and Electric Lighting Committee and the electrical engineer have been instructed to prepare and submit an actual working scheme for a restricted-hour system of charging for current for power purposes, and in the meantime they have been authorised to adopt a rate of charge on a restricted-hour system to about six consumers, with a view to obtaining further information before submitting the above-mentioned scheme.

The B.C. has adopted recommendations of the Electric Lighting and Tramways Committee accepting a tender for extending the power station, amounting to £3,827, and giving instructions to the electrical engineer to obtain tenders for new boiler plant, &c. The total extensions are expected to cost about £30,000. Considerable discussion ensued over a recommendation that the sum of £8,062, being the profit on the electricity undertaking up to March 31st, be placed to the reserve fund. Alderman Sinclair supported the recommendation on the ground that a reserve fund was absolutely necessary, having regard to the big extensions contemplated. Mr. David Davies raised the point as to whether the £8,000 was actual or merely paper profit. In reply, Ald. Sinclair said that but for the balance there would have to be an overdraft at the bank, so that in reality it was working capital. Mr. Davies considered it was not profit at all. The Committee's recommendation was adopted.

Watford.—The report of the district auditor states that the sale of current by meter produced during the year £9,336, as compared with £8,041 in 1909-10, or an increase of £1,321. The gross profit on the year's working shows an increase of £914 over the previous year, and after deducting instalments of loans and interest, the net profit to be transferred to the relief of the district fund is £790, which compares favourably with that transferred at the end of 1909-10, viz., £274, being an increase of £516. The total capital expenditure on the works now amounts to the sum of £99,229, as compared with £95,423 in 1909-10, the increase during the year being chiefly due to the cost of new machinery and the laying of new mains and services.

West Ham.—Sanction has been received from the B. of T. to the borrowing of £2,925 for the extension of the cables in connection with the tramway system.

Willesden.—The Council has had under consideration reports as to the expediency of supplying electrical contractors with electricity at special rates when their window show is of such a character as to advertise the Council's undertaking. The Committee states that during last winter two showrooms were opened in Kilburn, and it was desirable, in lieu of opening others during the ensuing winter, that the electrical engineer should, as an experiment for a period of six months, be empowered to make arrangements with any of the electrical contractors in the district who are prepared to make a satisfactory show of the apparatus belonging to the Council, or otherwise advertise the Council's undertaking, for the supply of the necessary current at a substantial rebate. This is to be done.

TRAMWAY and RAILWAY NOTES.

Bacup—Rochdale.—On Saturday the Bacup Corporation's new electric tramway to Shawforth was completed at a cost of £24,038, and trial cars were run preparatory to the B. of T. inspection by Major Druitt on the 25th inst., when through running between Bacup and Rochdale, a distance of seven miles, was arranged for. This important section of tramway links up a large radius of tramways throughout the County Palatine measuring about 100 miles. The new line to Shawforth, which completes the Bacup-Rochdale through system, is leased to the Rochdale Corporation for 30 years, at the end of which period it will be worked by the Bacup Corporation, whose property it will become. The new route is an intensely interesting one, and embraces the famous resort known as Healey Dell, between Bacup and Rochdale, which abounds in enchanting scenery.

Blackpool.—At a meeting of the Tramway Committee on July 20th, announcement was made that so far in the present financial year there has been an increase of £3,600 in revenue over the amount for the corresponding period of last year. The excellent Easter traffic was responsible for about £2,000 of this sum; and the continuance of the fine weather has made up the remaining £1,600. During the Aviation Carnival, when many thousands of people were carried, special through tramcars were run to the extreme end of the boundary at a charge of 6d. The Committee has decided on a through service from Talbot Square to the new racecourse during the coming steeplechase meetings at the ordinary fare of 4d.

Bradford.—The satisfaction given by the recently-instituted system of railless trolley cars in Bradford and Leeds is stirring up activity amongst the smaller authorities of the West Riding of Yorkshire. The Corporation has had a considerable number of invitations from outlying districts, at present unserved, to install the system on the respective routes desired. The District Council of Bingley, at a meeting last week, decided to approach the Corporation with a view to Bradford's running electric cars, railless or otherwise, *via* Nab Wood to Bingley. It was announced at the same meeting that a letter had been received from the Keighley Corporation asking for the Council's consent to the running of railless cars through Bingley to Nab Wood, to connect with the electric cars on the permanent way of the Bradford Corporation. The minute was unanimously adopted.

Bury.—The B. of T. has written to the Bury Corporation Tramways Committee suggesting that indicators be fixed on a certain number of cars in order that motormen may be trained in judging speed. Consideration of the matter has been deferred until the manager has reported to a future meeting.

Continental Notes.—GERMANY.—A scheme for the establishment of a railless service of electrical vehicles between Carlsruhe and Daxlanden is at present under consideration.

SPAIN.—Plans for a projected light electric railway for the transport of both passengers and goods between Vitoria and Santa Cruz de Camperol are being prepared by the Sociedad Electrica-Hidraulica Alavesa.

Dewsbury.—The T.C. has received a communication from the Yorkshire (heavy woollen district) Electric Traction Co., which owns the cars and has a lease of the track, &c., between Dewsbury and Cleckheaton, through Heckmondwike and Liversedge, and connecting with Thornhill and Ravensthorpe, asking that increased accommodation be provided for the cars in the semi-terminus at the west end of the Dewbsury Market Place. The application is under the consideration of the General Purposes Committee of the Dewsbury T.C.

Edinburgh.—Mr. Campbell, burgh engineer, in a report to the T.C. in regard to railless tramways, points out how much more cheaply the new system can be worked compared with the ordinary overhead electric tramways or cable tramways. In his opinion the railless system would be applicable for use in Fountain Bridge and other narrow thoroughfares in the city as well as for extensions into the country, where there would not be sufficient traffic to justify the cost of laying down a complete railed track. The Corporation Tramways Committee has recommended the Council to appoint Councillors Rusk, Rawson and Stewart and Mr. Campbell to visit Leeds and Bradford during the holiday season to inspect the new system.

Handsworth.—A petition, asking for a tramway to be constructed along Grove Lane and Oxhill Road is to be forwarded to the City of Birmingham Tramways Co.

Huddersfield.—Several tramway extensions are in progress at Huddersfield. The Newsome Road section which has been extended to Newsome Church, is the most recently completed, and it has been formally inspected by Major Druitt, of the Board of Trade. Cars were run over the extended route on Wednesday last week.

Leeds.—The Hon. John Murray, Premier of Victoria, Australia, paid a special visit to Leeds last week for the purpose of inspecting the newly inaugurated system of railless trolley cars. It is stated that since the commencement of the service in Leeds there has been an average of one deputation a day from tramway and other authorities in all parts of the country.

Liverpool.—The Tramways Committee at its meeting on July 21st, unanimously passed the following resolution:—"That each driver and conductor who has been in the service of the Corporation for a period of five years be granted 1s. per week merit pay, with an additional 1s. per week for each subsequent period of five years' satisfactory service from the date of the resolution." There are about 1,600 tram drivers and conductors in the service of the Corporation, and this new regulation immediately applies to 1,400 of them, involving an increased annual charge upon the tramways department of £3,500 a year.

Superintendent Cross, of the Lancashire County Police, has written to the Liverpool Corporation tramways manager, conveying this thanks for the efficient help rendered by Mr. Gallagher (foreman at the Litherland depôt) and other tramway employés, at the recent fire in Linacre Road, Litherland, Liverpool, when six persons lost their lives. The Tramways Committee has awarded 10s. each to the employés who rendered assistance on that occasion, together with an expression of the Committee's appreciation of their promptness and courage.

Llanelly.—The official inauguration of the local tramway system took place last week. Mr. Balfour, of Balfour, Beatty and Co., Ltd., the contractors for the work, presided over a preliminary luncheon, which was followed by an inspection of the power station and tramway.

London.—L.C.C.—The Council is recommended to seek Parliamentary powers in the session of 1912 for seven tramways, the estimated cost of which, including equipment, &c., is £274,820, while road widenings will cost over £88,000.

EAST LONDON RAILWAY ELECTRIFICATION.—At the half-yearly meeting held on the 25th inst., Lord Claude Hamilton announced that the six leasing companies had passed a resolution which practically ensured the immediate electrification of the line. The engineers estimated the cost at £65,000; and the extra working expenses incidental to the electrification were put at £3,000 a year. The District Railway Co. would supply power from its Lot's Road station, and the Metropolitan Railway could probably supply the necessary rolling stock. It was proposed to run four through Metropolitan trains per hour to New Cross and eight locals between Shoreditch and New Cross (S.E. and Brighton stations alternatively).

Manchester.—On Tuesday the Tramway Committee received a report from Mr. McElroy, the general manager, to the effect that no difficulty had been experienced in granting free passes on the cars to blind people during the past year, and the Committee decided to recommend a continuance of the privilege provided that the passes are renewed annually. Last year 291 applications for free passes were made, and 261 granted. The refusals were on the ground that the applicants did not live in the Manchester area.

Oldbury.—The U.D.C. has requested the Electricity and Tramways Committee to consider the possibility of arranging for a service of railless trolley cars between Oldbury and Blackheath and Langley.

Perth.—The Tramway Committee of the T.C. had a good time last week. It was recently resolved to acquire two motor-char-a-bancs as feeders for the electric cars, and the members of the Committee, comfortably seated in motor-cars, were on a tour inspecting different makes of cars.

Portsmouth.—The T.C. has been recommended to extend the electric tramways in three parts of the town, at an estimated cost of £31,500.

Rawtenstall.—The draft agreement for the supply of current from the Rawtenstall Corporation for the working of the Bacup Light Railway, is now under consideration by the Rochdale Corporation.

Swansea.—At last week's meeting of the B.C. the report of a special committee was presented containing the heads of agreement between the Corporation and the Swansea Improvements and Tramways Co. for the acquisition of the tramways by the Corporation. This provides for the working of the entire tramway system by the company for a period of 31 years from December 31st last, 7 per cent. per annum being paid in respect of the capital laid out upon the Corporation sections during the 15 years extending beyond the period covered by the existing leases, and an additional £920 in the event of the net profits in any year admitting of the payment of 6 per cent. to the shareholders of the company. At the end of the 31 years the Corporation has the option of purchasing all the company's lines at their constructed value. An important concession obtained from the company is the privilege for working men of travelling at all times at a reduced rate of ½d. per mile with a minimum fare of 1d. Mr. David Davies said that if the Corporation failed to accept the agreement substantially, it would be committing an irreparable blunder. It was resolved to hold a special meeting of the Council to discuss the clauses of the proposed agreement.

U.S.A.—According to the *Financial Times*, the City of New York has awarded the whole of the work of subway extension to the Brooklyn Rapid Transit Co. The extension will cost $225,000,000.

TELEGRAPH and TELEPHONE NOTES.

Atlantic Cable Rates.—In the course of a discussion in the Ottawa House of Commons recently, the Postmaster-General, Mr. Lemieux, stated that he had been informed by Mr. H. Samuel that the English and German cable companies had agreed to a reduction of the rates to 6d. a word for "semi-urgent" messages not in code, but that the French companies were holding out against the reduction. It was hoped that the difficulty would soon be overcome.

Automatic Telephone Exchanges.—The automatic exchange to be installed at Epsom by the Post Office will be of the Strowger type; for the purpose of comparison, it has been decided to install one on the Lorimer system at Caterham, the capacity being 500 lines in each case.

Belgian Telephone Case.—In the action for £8,000 damages brought against the Bell Telephone Co. by the electrical engineers who were recently prosecuted by the company for betraying trade secrets and were acquitted, the Civil Tribunal has declared that the claim is admissible, and has ordered the case to proceed.

Loaded Telephone Circuits in the U.S.A.—In a paper read before the American Institute of Electrical Engineers, Mr. B. Gherardi stated recently that in the United States there were 85,000 miles of loaded open-wire circuits, and over 170,000 miles of loaded underground circuits, requiring the use of 125,000 loading coils. The coils used were about 10 in. in diameter, and the resistance of the two windings was 2½ ohms, with an impedance of 6½ ohms at 800 cycles per second. By loading, the distance of telephonic transmission over No. 8 B.W.G. wire had been increased from 1,000 to 2,000 miles.

New Pacific Cable.—A Bill providing for the construction and working of a new Pacific cable was read a first time in the House of Commons on Tuesday last.

Telegraph Construction Bill.—This week a Committee of the H. of C. has been considering a Bill to enable the P.M.G. to carry telegraph wires over railways without payment to the railway companies. Three Scotch companies opposed the Bill, claiming compensation for the loss of existing rights.

Wireless Telegraphy.—Three inspectors of wireless telegraph apparatus on vessels have been appointed by the Department of Commerce and Labour of the United States Government. The law requiring all passenger vessels plying from United States ports to have "wireless" equipment sufficient to call for help in

cases of emergency is now in force, and all vessels will be inspected to see that they comply with the law. It will be the duty of the inspectors to go aboard all outgoing vessels carrying more than 50 passengers, not only to inspect the apparatus itself, but to pass judgment upon the qualifications of operators. No vessel will be permitted to leave a United States port without a certificate of inspection. If an inspector is not at hand the master of the vessel is required to deposit a certificate with the Customs officials. Wireless operators holding certificates by the Governments which ratified the Berlin Wireless Telegraph Conference will be acceptable to the United States authorities. To secure a certificate from the United States Government it will be necessary for operators to pass an examination.—*Electrical World.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—Tenders for four double-deck cars. Drawings and specifications from R. Stuart Pilcher, general manager.

Australia.—VICTORIA.—August 15th. 80,000 insulators, and india-rubber-covered wire, for the P.M.G.'s Department. See "Official Notices" June 30th.

August 8th. Measuring instruments, telephone instruments and parts, and 25 trembling bells, 8-in. gong, for the P.M.G.'s Department. See "Official Notices" July 7th.

August 9th.—530 A.C. meters, 496 D.C. meters and 133 maximum-demand indicators, for the Melbourne City Council. See "Official Notices" to-day.

September 5th.—(*a*) 10,000 protectors and (*b*) sundries, for the P.M.G.'s Department. See "Official Notices" to-day.

SOUTH AUSTRALIA.—August 9th. (*a*) Letter-box fronts; (*b*) four petrol motor cars, for the P.M.G.'s Department. See "Official Notices" June 30th.

August 23rd.—Telegraph and telephone material for the P.M.G.'s Department. See "Official Notices" July 7th.

August 30th. P.M.G. Insulators, copper wire and sleeves. See "Official Notices" July 14th.

NEW SOUTH WALES.—August 9th. P.M.G. Letter-box fronts. See "Official Notices" July 7th.

August 8th.—According to an Australian exchange tenders are invited for electrical generators, storage batteries, and voltmeter, for the Stores Supply Department, 15, Young Street, Sydney. A. Berckelman, executive member.

Telephone, telegraph and electric light material for a year, and a dessiccating plant for the P.M.G.'s Department. See "Official Notices" to-day.

QUEENSLAND.—August 23rd. Letter-box fronts, for the P.M.G.'s Department. See "Official Notices" June 30th.

August 16th.—Cable, conduits, cast-iron pipes, iron poles, insulators, wire, &c., for the P.M.G.'s Department. See "Official Notices" July 7th.

WESTERN AUSTRALIA.—August 2nd. Telegraph and telephone material for the P.M.G.'s Department. See "Official Notices" July 7th.

Austria.—August 1st. The Austrian State Railway authorities at Stanislau are inviting tenders for the supply of five continuous-current electric motors for the railway works at that place.

Belgium.—The municipal authorities of Tongres are inviting tenders until August 5th, for the extension of the electric lighting undertaking in the town.

Brazil.—August 21st. Electric goods lift and electric crane for the Naval depôt on the Island of Cobras. Local representation. Deposit £33. Inspectoria de Engenharia Naval, Ministerio da Marinha, Rio de Janeiro.—*Board of Trade Journal.*

September 25th.—All electric lighting fittings, fans, lamps, insulated conductors, &c., required in connection with the equipment of the new Postal Telegraph building in Port Alegre with electric light. Value about £3,100. Local representation. Deposit about £33. Directoria Geral do Expediente, Ministerio da Viacão e Obras Publicas, Rio de Janeiro.—*Board of Trade Journal.*

Bulgaria.—The T.C. of Philippoli is prepared to receive up to August 4th, tenders for a gas lighting and electric tramways concession for a period of 50 years. Guarantees 80,000 and 90,000 fr. respectively.

Canada.—August 10th. According to the *Canadian Engineer* tenders are invited in connection with the municipal installation at Penticton, B.C., for two 100-K.V.A. three-phase, 4,600-volt, 900 R.P.M., A.C. generators direct connected to impulse wheels operating at 2,045 ft. effective head, pressure pipe line of about one mile of 10-in. and one mile of 12-in. pipe, switchboards, transformers, meters, distribution and street lighting system. For further particulars see this column last week.

Erdington (near Birmingham).—Construction of 1¼ miles of double-track tramway. H. H. Humphries, engineer to the Council, Council House, Erdington.

Farnham.—August 16th. Two high-speed Diesel oil engines coupled to two 90-KW. alternators, with direct-coupled exciters, piping, tanks, overhead traveller, &c., and main H.T. switchboard, for the Farnham Gas & Electricity Co. See "Official Notices" July 21st.

Frodingham.—August 11th. Poles, lamps, wires and switches for street lighting, for the Brumby and Frodingham U.D.C. See "Official Notices" July 21st.

Hungary.—August 2nd. Electric lighting plant (public and private) for the authorities of the Grossgemeinde Pászto, Komitat-Heves, Hungary.—*Board of Trade Journal.*

London.—L.C.C.—August 1st. Electrical installation (250 lamps) at the Gt. College Street Elementary School, N.W. See "Official Notices" July 21st.

Pembroke (Co. Dublin).—July 31st. Installation of electric light in new artisans' dwellings and in new streets, for the U.D.C. Deposit 20s. Specifications, &c., J. C. Manly, clerk, Town Hall, Ballsbridge, Pembroke. Irish materials and labour and Dublin standard rate of wages.

Pontypridd.—August 1st. 1,700 ampere-hour storage battery, with motor-driven booster and switchgear, for the U.D.C. See "Official Notices" July 21st.

Rochdale.—August 2nd. Twelve months' supply of paper-insulated cables. Specification and form of tender obtainable from C. C. Atchison, engineer and manager, Dane Street, Rochdale. Deposit of £2 2s. (returnable).

Russia.—The T.C. of Stavropol (Caucasus) is open to receive tenders for the installation and working of an electric tramway service. The last day of submission is August 14th.

Salisbury.—Electric lighting of the Salisbury and District Joint Isolation Hospital. See "Official Notices" to-day.

Spain.—The municipal authorities of Matilla de los Canos (province of Salamanca) have recently invited tenders for the concession for the electric lighting of the town.

Sweden.—Tenders are invited by the Swedish Postal Authorities for the supply of 4,000 to 6,000 metal-filament lamps, 16-50 normal C.P., and for 110-250 volts. Tenders, marked "Anbud a Metalltradslampor," will be received up to August 1st at the Generalpoststyrelsens Registratorskontor, Vasagatan, Stockholm.—*B. of T. Journal.*

Tonyrefail.—August 1st. Mains, switchgear, and street lighting fittings at the Ely Valley Extensions, for the Tonyrefail and Gilfach Goch Electric Light Co., Ltd. See "Official Notices" July 21st.

Turkey.—Tenders are invited for concessions (1) to establish a public water service; and (2) an electric installation for lighting and traction purposes in the city of Jerusalem and its suburbs. Guarantees, 1,000 and 2,000 £T respectively.

Warrington.—August 9th. Motor-driven induced-draught fan, for the Corporation. See "Official Notices" to-day.

Whalley.—Electrical plant, &c., for the new asylum. The Lancs. Asylums Board will shortly invite tenders for the above from a selected number of firms. See "Official Notices" to-day.

Wolverhampton.—Buildings and plant for a 1,000-KW., 440-volt direct-current generating station, for the Knowles Oxygen Co., Ltd. See "Official Notices" July 14th.

CLOSED.

Belfast.—The Tramways and Electricity Committee has accepted the tenders of the Rees Roturbo Manufacturing Co. and the Worthington Pump Co., for circulating and air pumps respectively.

Bolton.—We are informed that the name of the Electrical Apparatus Co., Ltd., should have been included in the list of tenders accepted for electricity meters published in our last issue.

Derby.—The E.L. Committee of the T.C. has accepted the following tenders:—

Messrs. W. Rickard, Ltd.—Cable, £913 13s. 6d.
The British Electric Transformer Co.—Transformers, £696 10s.
Messrs. A. Reyrolle, Ltd.—Sub-station switchgear, £342.

France.—The French Post and Telegraph authorities in Paris last week gave out contracts as follows:—La Société de Commentry-Fourchambault et Decazeville, 15 tons of iron wire 1 mm. dia., and 100 tons ditto, 3 mm. dia.; La Société des Forges Treflieries et Pointerie de Creil, 100 tons ditto, 4 mm. dia.; and La Société des Forges de Chatillon-Commentry, 100 tons ditto, 4 mm. dia.

Huddersfield.—The following tenders for 10 new cars have been accepted, viz.:—Car bodies, United Electric Car Co.; electrical equipment, Dick, Kerr & Co., Ltd.

Irish Town Lighting Contracts.—The Swinford (County Mayo) R.D.C. has accepted the tender of the National Gas Engine Co. for the electrical plant for the lighting of the town. The plant will include two 28-KW. sets, comprising National gas engines, with suction gas plant, coupled direct to two continuous-current generators, and one motor booster, storage batteries, &c., by the Electric Construction Co.

The tender of the General Electric Co., Ltd., for the lighting of Charleville, has been accepted. The plant will comprise a 30-KW. National gas engine, with suction gas plant, coupled direct to a G.E.C. continuous-current generator.

Loddon and Clavering.—The B. of G. has accepted the tender of Messrs. A. Pank & Co., of Norwich, for an installation of electric bells at the workhouse, at £23.

London.—HAMMERSMITH.—The following tenders were received for lanterns for side street lighting :—

	Bracket, switch, and hood.	Fitting for converting gas lamps to electric.
Reason Manufacturing Co.	£0 16 0	£0 17 0
	1 1 0	0 16 0
	0 13 6	
	1 6 6	
Haydn Harrison & Co.	0 17 0	0 13 6
	0 17 0	0 12 0
	0 17 0	
	0 16 6	
Lucy & Co.	0 15 5	0 11 8
	0 16 2	
	0 15 8	
	0 18 6	
	0 18 5	
Wardle Engineering Co.	1 8 0	0 15 6
	1 4 6	0 15 6
	1 3 6	
	1 7 5	
	1 2 9	
General Electric Co.	1 2 6	0 16 6
	1 4 6	
	1 15 0	
Wm. Edgar	1 19 6	1 16 6
Pontifex & Co.	1 5 6	0 15 0
Falk, Stadelmann & Co.	1 0 6	0 16 6
	0 19 0	

The Electricity Committee recommends that the tender of Messrs. Lucy & Co. for the supply of bracket and switch for the sum of 8s. 10d. each be accepted, and that hoods be purchased from the General Electric Co. at 8s. 3d., of the same type as that approved by the Council in connection with the scheme for the hiring out of fittings for the external lighting of business premises.

The following tenders were received for the supply of time switches for public electric lamps, viz. :—

Venner & Co.	£1 11 0	£1 12 8	£1 17 0
Laing, Wharton & Co.	1 14 0		
Reid & Co.	1 14 0	1 13 0	1 12 9
Engineering & Arc Lamps, Ltd. ..	1 19 0		
General Electric Co.	2 0 0	3 10 0	4 0 0
Ferranti, Ltd.	2 10 0		

The engineer has reported as follows upon the proposals received :—

"The lowest price received is 31s. per switch, and as some 700 instruments will be required, the total cost will be £1,085. Taking this sum borrowed at 3¾ per cent. interest and repayable in five years the annual sum required for repayment of principal and interest will be £266, whilst taken on the basis of repayments spread over 10 years, the annual amount required will be £153.

"At present 11 men are employed attending to trimming, cleaning, maintaining, repairing and switching the public lamps, the average weekly cost being £16 15s. Under the proposed arrangement of conversion from arc lamps to incandescents, and with the extra lamps now being changed over from gas to electricity and not using automatic switches, I estimate three men less will be required, meaning a saving of about £236 per annum. With time switches installed the extra work of attending to the instruments would enable the services of only one more man to be dispensed with, amounting to £73 per annum.

"Accordingly, the estimated saving in wages if time switches are installed will be £73 per annum, as against a cost of £266 per annum, for repaying loan for the purchase of the instruments, taken on the basis of a five-year loan.

"There will also be a small saving in bicycle hire, which now amounts to 5s. per week."

The Electricity Committee recommends that in view of the cost involved in carrying out the proposed installation of time switches, no further action should be taken in the matter at the present time.

The Electricity Committee recommends the acceptance of the tender of Messrs. Nichols Bros., of Gateshead, for a 24-in. stroke feed pump, at £190 15s. Eleven tenders were received ; the first seven did not comply with the specification. Also that the tenders of Messrs. Wm. Cory & Son, Ltd., for the supply of "Seven Sisters" hard dry coal, at 11s. 3d. per ton, and for 2,000 tons of "Nixon's Navigation" free-burning coal, at 13s. 6d. per ton, be accepted ; and that that of the Main Colliery Co. for the supply of "Graigola and Victoria" free-burning coal, at 13s. 11d. per ton, be accepted.

L.C.C.—The following (fresh) tenders were received by the Fire Brigade Committee for the electric lighting (wiring and fittings) of Kennington fire station :—

Alex. Hawkins & Sons	(accepted)	£239 0 0
W. J. Fryer & Co.		242 18 0
G. E. Taylor & Co.		269 15 0
Tilley Bros.		269 15 0
Pinching & Walton		287 1 2
John Bryden & Sons		314 0 0
Chief Engineer's estimate		260 0 0

Tenders were also received for the wiring and supply of fittings for electric lighting at Shadwell and Stoke Newington fire stations :—

(1) SHADWELL FIRE STATION.

Malcolm & Allan, Ltd.	(accepted)	£202 15 9
Tilley Bros.		206 9 0
E. Newbald & Co.		236 0 0
G. Harland Bowden & Co.		280 0 0
Tredegar & Co.		280 4 0
Chief Engineer's estimate		212 0 0

(2) STOKE NEWINGTON FIRE STATION.

W. J. Fryer & Co.	(accepted)	£168 15 8
Foote & Milne, Ltd.		176 17 2
E. Lawrance & Sons, Ltd.		185 0 0
G. Weston & Sons, Ltd.		185 0 0
Waring & Withers		214 10 9
Lund Bros. & Co.		220 0 0
Chief Engineer's estimate		180 0 0

The Committee is asking sanction for an estimated capital expenditure of £1,255 for an electrically-driven motor turntable long ladder.

The Highways Committee recommends the sealing of a contract with Messrs. Hadfield's Steel Foundry Co., Ltd., for points, junctions, crossovers, &c., required for tramway renewals during 1911-1912, at £13,245 15s.

The Fire Brigade Committee recommends an expenditure of £90 on electric radiators for various fire stations.

STEPNEY.—With regard to the supply of energy by the Council to the Port of London Authority, special meters, each consisting of a combination of meter and restricted-hour demand indicator, were required, and the offer of the Aron Electricity Meters, Ltd., to supply the meters at £164 5s. has been accepted.

LONDON AND NORTH-WESTERN RAILWAY.—Messrs. W. Geipel and Co., of Vulcan Works, St. Thomas Street, S.E., have for the third time secured a contract for the annual supply of Henrion arc lamp carbons, open, enclosed and flame types, amounting to nearly 1,150,000 carbons.

CHELSEA.—The Chelsea Electricity Supply Co., Ltd., has accepted the tender of Messrs. Ed. Bennis & Co., Ltd., Bolton, for a bucket coal elevator to feed four chain grate stokers.

FULHAM.—The Electricity Committee recommends that a tender of the British Westinghouse Co., at £210, be accepted for extensions to the main switchboard at the generating station.

ST. PANCRAS.—The B.C. received the following tenders for cables :—

Western Electric Co., Ltd.	(accepted)	£1,352
Henley's Telegraph Works Co., Ltd.		1,383
Siemens Bros., Ltd.		1,396
B.I. and H. Cables, Ltd.		1,415
Callender's Cable Co., Ltd.		1,444

The tender of E. C. and J. Keay, Ltd., at £261, to provide a boiler-house roof at the King's Road generating station, and to carry out the lengthening of girders at the station, has been accepted.

MARYLEBONE.—The B.C. has accepted the tender of the Electrical Co., Ltd., for the supply of lamps for street lighting.

Manchester.—The Co-operative Wholesale Society, Ltd., of Manchester, have placed the contract for wiring, erecting and setting to work three A.C. motors and control gear, for their central premises in Deardengate, Haslingden, with Mr. A. M. Cramp, of Regent Street, Haslingden.

Morecambe.—The T.C. has ordered two "Bennis" stokers and self-cleaning compressed-air furnaces for the electricity works.

Redditch.—For the extension scheme of the U.D.C., Mr. W. J. Ferguson, the electrical engineer, informs us that 26 tenders were received, and the Council has accepted the following :—

Mixed pressure turbine and single-phase alternator.—Messrs. Willans and Robinson, Ltd., Rugby, for Willans turbine and Parsons alternator, £2,111.

Condensing plant.—Messrs. Willans & Robinson, Ltd., Rugby, for Willans augmentor condenser and Balcke cooling tower, at £888.

Pipework.—Mr. Ed. White, Redditch, at £549.

Southend.—The T.C. has accepted the tender of the Worcester Foundry Co. for 47 brackets for the electric lighting of the pier, at 16s. 9d. each.

Stoke-on-Trent.—The Electricity Committee of the Stoke-on-Trent Town Council has accepted the tender of the Sterling Boiler Co., at £5,044, for three boilers and all accessories for the new works ; also the tender of the Davenport Co. (Bradford), at £1,035, for a new cooling tower.

Street Lighting Contracts.—The progress of electrical street lighting is well exemplified by a number of important contracts recently placed with Mr. Haydn Harrison for the supply of his special grouped H.C.P. tungsten lanterns for street lighting. He is converting from gas to electric lighting 7 miles of streets at Beckenham, and 7 miles at Caversham ; at West Hartlepool, Lancaster, Walker and the Curragh Camp, he is supplying large tungsten lamp fittings ; and at Maidstone, Tunbridge Wells and Battersea (436 arcs), he is replacing arc lamps with tungsten lanterns. He is also supplying them to the Imperial Paper Mills, Gravesend, and the new car sheds and repair shops connected with the electrification of the L.B. & S.C. Railway.

Swansea.—The E.L. and Tramways Committee of the T.C. has accepted the tender of the Electric and Ordnance Co., Birmingham, for a two years' supply of motors.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—Col. H. M. LEAF.

The following Orders are issued for next week :—

Saturday, July 29th.—Falmouth Detachment will parade at headquarters at 8.30 a.m. Weymouth Detachment will parade at headquarters at 11 a.m. Dress for the above detachments will be :—Service dress, drill order, with waterbottles and haversacks. Arms will be issued before each parade.

Headquarters will open from 10 a.m. to 4 p.m. from Monday, July 31st, to Friday, August 4th.

Saturday, August 5th.—Falmouth Detachment (2nd party) will parade at headquarters at 8.30 a.m. Weymouth Detachment (2nd party) will parade at headquarters at 11 a.m. Dress for the above detachments will be :—Service dress, drill order, with waterbottles and haversacks. Arms will be issued before each parade.

(Signed) P. H. CARPENTER, Capt. R.E., Adjutant for O.C. London Electrical Engineers.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Saturday, July 29th, to Saturday, August 5th. Summer meeting. Visits to works, &c., at Felixstowe, Ipswich, Norwich and Cambridge.

Friday, August 4th. At the University Arms Hotel, Cambridge. Summer dinner.

NOTES.

Electrical and other Fatalities.—Deputy-Coroner Shepherd conducted an inquiry on 11th inst. into the circumstances attending the death of Robert Anderson, of Hebburn, an electrical jointer, who was killed on 10th inst. at the Jarrow sub-station of the Durham County Electric Power Distribution Co. Robert Anderson, the father of the deceased, who was a labourer at the power station, said that at the time of the accident he was assisting deceased to uncover an oil switch. They had completed their work and his son got upon an angle bar. There was a sudden flash, after which he saw him lying on the floor of the chamber dead. Henry Alfred Myles, senior assistant engineer, said that after the oil tank was removed, he examined the switch and told the deceased to file the contacts. Witness stated, in answer to Mr. W. Lauder, Factory Inspector, that he did not put in the trays to protect the terminals. He did not think it necessary. Having drawn Myles's attention to the regulations, Mr. Lauder asked: Were all the conductors in the cell made dead while the work was being conducted there?—Witness: No. Mr. John McLaren, the company's district engineer, agreed that the regulations had not been observed, but said that the places where Anderson had to work had been made dead. Witness, in reply to Mr. Burton, representing the company, said that if the deceased had done nothing but his work an accident would have been impossible. It was stated that deceased received a shock at about 12,500 volts. The jury returned a verdict of "Accidental death," and expressed the opinion that the accident would not have occurred if the regulations had been complied with.

Deputy-Coroner Shepherd also held an inquiry on the 11th inst. into the circumstances of the death of Robert Cragg, an electrician, who was killed at Swalwell Colliery on 8th inst.—William Olman, a joiner, stated that Cragg and he were preparing to start a motor which worked a pump in the Brockwell seam, and when Cragg touched the switch casing he found it was "alive"; almost immediately afterwards he received another shock, which proved fatal. Cragg had india-rubber gloves, and was wearing one.—Arthur Gibson Booker, an electrician, who said the current was 440 volts alternating, stated that he noticed that the back of the switchboard was off, there was no earth wire connected to the pillar, and one of the contacts was askew.—The Deputy-Coroner said the Government Electrical Inspector might desire to attend the inquiry, and he adjourned the inquest for that purpose. The inquiry was closed on the 18th. The evidence was gone over, and the jury returned a verdict that death was due to the effects of an electric shock accidentally received while examining a switch pillar at Swalwell Colliery, for the purpose of discovering a leakage of electricity.

On the 18th inst. an inquest was held at Barnsley regarding the bursting of a steam valve at the Grimethorpe Colliery on the 10th inst., by which three persons were killed—Frank Green, colliery engineer, John Allen, enginewright, and Herbert Duckworth, foreman fitter in the employ of Messrs. Vickers, Sons & Maxim, Ltd., Sheffield. Mr. Gill, manager of the colliery, explained that a new turbine had been fitted up by Messrs. Vickers to generate electricity for the colliery, and this was coupled up with the boilers by pipes supplied by another firm. The pipes had been tested and proved satisfactory, and after adjustment had been made, a further test was being conducted when the accident occurred. The bursting of the valve was due to the presence of water in the pipes, which caused "water hammer." In reply to Sir William Clegg, witness said there was no fault to be found with Messrs. Vickers's work. Mr. Wilson, Inspector of Mines, gave evidence as to the result of his inspection, and said there could be no doubt that the pipes were full of water before the test was made, and the real cause of the accident was the absence of a drain pipe. The jury returned a verdict of "Accidental death," and expressed the opinion that the accident was caused by the want of an outlet for the condensed steam from the pipes.

An inquest was held on Tuesday last at Pendlebury touching the death of Sydney J. Douglas, 31, electrician, who had been employed as assistant mains engineer by the Lancs. Electric Power Co. Evidence of identification having been given, Roger F. Hutchinson, an electrical engineer in the employ of the company, was afterwards called, and stated that he accompanied the deceased on Saturday to the Pendlebury sub-station for the purpose of locating a fault in the H.T. feeder. While the deceased was in the H.T. chamber there was a sudden flash, and when witness and the sub-station attendant ran in they found Douglas lying near a live switch carrying 10,000 volts, which deceased had apparently touched. He was promptly released and carried outside, but lived only a few minutes. Witness said that he and the attendant were in the low-tension chamber at the time and did not see exactly how the accident occurred. He thought, however, that Douglas was examining the blank oil switch. There were two sides to the switch, one alive and one dead, and he thought the deceased mistook which was which and touched the live one. It was stated that the deceased was an experienced electrician, and was known as a cautious man.—Mr. Leslie, mains superintendent to the company, said that the deceased had been instructed to locate a fault. The most probable cause of the accident was that the deceased touched the live switch in a moment of forgetfulness. If the switch was faulty, there was a method known to witness and the deceased whereby it could be examined without touching it. There were stringent regulations against touching switches which were alive. The use of the rubber mat would have been no protection against such a high voltage. A verdict of "Accidental Death" was returned. Mr. Taite, manager of the Electric Power Co., expressed profound regret at the fatality and sympathy with the deceased gentleman's family.

On Monday morning last, Mr. Arthur Street, assistant electrical engineer to the Batley Corporation, received fatal injuries as the result of a motor-bicycle collision at Allwoodley. He succumbed to his injuries on the way to the infirmary. He leaves a widow and five children.

Institution and Lecture Notes.—ASSOCIATED MUNICIPAL ELECTRICAL ENGINEERS (GREATER LONDON).—The A.M.E.E. held their annual general meeting at the Institution of Electrical Engineers on July 5th, and the following executive officers were appointed for the session 1911-1912: President, W. C. P. Tapper, Stepney. Vice-Presidents, F. A. Bond, Battersea; L. L. Robinson, Hackney; A. H. Shaw, Ilford. Hon. Treasurer, G. G. Bell, Hammersmith. Hon. Auditors, J. G. Bruce, Willesden; E. Calvert, Finchley. Hon. Secretary, Norman Staniland, Hornsey. Council, S. W. Baynes, St. Pancras; J. H. Bowden, Poplar; H. H. Couzens, West Ham; C. S. Davidson, Barnes; A. J. Fuller, Fulham; F. Hill, Hammersmith; W. Innes, Poplar: C. Newton Russell, Shoreditch; P. E. Rycroft, Heston; E. Sayer, Hampstead; A. H. Seabrook, St. Marylebone; W. C. Ullmann, East Ham.

ROYAL SOCIETY OF VICTORIA.—In a paper on "The Magnetic Properties of Stalloy," by H. R. Hamley, M.A., and A. L. Rossiter, B.Sc., read in November last, and recently published, the authors give an account of a research on the above subject, and state the following conclusions:—"Stalloy" cannot be used to advantage in the unannealed condition. In the annealed state the results obtained fully bear out the claims made by the makers, the permeability being very high and the losses small, particularly the eddy-current loss. "Stalloy" behaves very much like ordinary iron under varying frequencies, and the constancy of the value of the hysteresis loss for different frequencies is remarkable.

The research was carried out at the University of Melbourne, where the authors were Government Research Scholars with Prof. Lyle.

Chinese Trade.—Referring to a number of reports from diplomatic and consular representatives in the chief trade centres in China, the *Financial Times* remarks that one pleasant feature noticeable in running through the reports is the strain of compliment toward the enterprise of British merchants, which has replaced the old attitude of tired expostulation against the continuance of obsolete methods. Mr. R. S. Pratt, at Canton, states that signs are not wanting that British merchants and manufacturers have succeeded to a considerable extent in revising their ideas of the exploitation of the China market. Showrooms for machinery, &c., have been opened in important centres, the use of advertisements in native newspapers and by the exhibition of posters is extending, and some firms have sent out travellers, accompanied by good interpreters, to various inland marts, and have found their enterprise well rewarded. One prominent firm in Canton is making the interesting experiment of employing University-trained men to act as agents and travellers. The reason given is that the Oriental is a keen admirer of education, and is quick to discern whether a man is well educated or not, and it is therefore important that those who come into contact with him should be men that he can respect. Altogether the commercial outlook seems promising, and with the development of the railways the demand for foreign goods should rapidly increase.

"Electrical Review" Rifle Club.—On Thursday last week, the prizes and the Bell, S.M.R.C., and *Express* medals, awarded in connection with the annual and other shooting competitions held during the season 1910-11, were distributed by Mr. H. Alabaster, the president of the club, who congratulated the members on the progress made in shooting during the three years the club has been in existence.

M.E.T. Sports.—The fourth annual athletic sports meeting of the Metropolitan Electric Tramways, Ltd., took place on July 20th, at the Tufnell Park Athletic Ground. There were 357 competitors down to take part in the lengthy programme of events, and the military band of the M.E.T. beguiled the proceedings with music. The attendance was all that could be desired, and the organisers are to be congratulated on the success of their efforts.

Insurance at Fleetwood.—The insurance of workmen has become a burdensome matter for employers. Messrs. Walmsley and Oldham sent in to the Council a tender for £3 7s. for tarring the cooling tower at the electricity works. The Council required the workmen to be insured, and the premium for this was £2 10s., nearly as much as the cost of the work. The tender is now £5 17s.

Holborn Street Lighting.—The B.C. on Wednesday accepted the joint tender of the Metropolitan E. S. Co. and Gas Light & Coke Co., for street lighting for 10 years, at £7,645 per annum subject to the L.C.C. consenting to the form of contract.

Educational Notes.—City and Guilds (Engineering) College.—The Council of the City and Guilds of London Institute have awarded the diploma of "Associate of the City and Guilds of London Institute" to 96 matriculated third-year students of the City and Guilds College who have completed a full course of instruction as prescribed by the Council—56 in Civil and Mechanical Engineering, 30 in Electrical Engineering, and 10 in Chemistry. Mr. C. O. C. Reilly has been awarded the Bramwell Medal, and Mr. A. H. Barrett the Siemens Memorial Medal.

University of Bristol.—Particulars of the new sessions, &c., are given in our advertisement pages to-day.

Northampton Polytechnic Institute, London, E.C.—Full day courses in mechanical and electrical engineering and electrochemistry will be commenced on Monday, October 3rd, 1911. For further particulars, see our advertisement pages in this issue.

University of London: King's College.—Some particulars regarding the Faculty of Engineering are given in our advertisement pages to-day.

Appointment Vacant.—Assistant clerk for the Shanghai Municipal Council Electricity Department (£24 per month). See our advertisement pages in this issue.

The Australian Tariff.—It has been decided in connection with the British preferential tariff of the Commonwealth, that goods in which all manufacturing processes are performed in the United Kingdom from unmanufactured raw material of foreign origin, are entitled to preference irrespective of the proportion of the value produced by British labour. The wording of Paragraph 2 of the certificate required in connection with shipments of British goods for which preference is claimed, is to be so interpreted.—*Financial Times.*

Inquiry.—The name of makers of electrical apparatus for heating large type in heavy box-side branding machines is asked for.

The Whitehall Club.—On July 20th, the ceremony of laying a commemorative stone at the new premises of the Whitehall Club, in Princes Street, took place in the presence of a large gathering of representative engineers. The stone, which is situate in the wall of what will form the hall of the new buildings, was laid by Mr. Alexander Siemens, president of the Institution of Civil Engineers. The chairman of the club, Mr. G. Midgley Taylor, in opening the proceedings, pointed out that, as the club buildings were now well advanced in construction, this could not be considered as a foundation stone, but that it would bear a tablet which would serve to remind the members that their club did not date merely from the opening of the new building. Associated with Mr. Siemens in the laying of the stone were Mr. Edward B. Ellington, president of the Institution of Mechanical Engineers, and Major W. A. J. O'Meara, C.M.G., vice-president of the Institution of Electrical Engineers. The usual mementoes (a copy of the *Times*, coins, &c.) were inserted in a cavity in the stone. A vote of thanks to the presidents concluded the ceremony, and the meeting then adjourned to the Westminster Palace Hotel, where upwards of 100 members and guests took luncheon. The toasts afterwards proposed included the health of the presidents of the three institutions, proposed by the vice-chairman of the club, Mr. G. N. Abernethy, that of the guests, proposed by the chairman of the club, and that of the Whitehall Club, proposed by Sir Robert W. Perks, Bart. Mr. Siemens, in responding as president of the Institution of the Civil Engineers, alluded to the fact that that institution was erecting a building at the other end of Princes Street, adjacent to the club premises. Mr. Ellington and Major O'Meara also spoke of the convenience the club was likely to be to engineers. Sir Henry Tanner, president of the Concrete Institute, who replied to the toast of the guests, in the absence of Sir Wm. Hall-Jones, alluded to the want of a non-political club in Westminster. Sir Robert Perks, in proposing the toast of the Whitehall Club, noted that the club was founded in 1869 by many of the then leading engineers in Westminster. The chairman responded, and the proceedings then terminated.

A Manchester Printing Works.—Practically the whole of the Irkdale Printing Co.'s works are now driven electrically, power being purchased from the Manchester Corporation in the form of three-phase current at 2,600 volts and 50 cycles. Approximately 255 H.P. of A.C. motors have been installed, varying in size from 5 to 50-H.P., and about 240-H.P. of D.C. motors, varying in size from 5 to 40 H.P. For the A.C. motors the pressure of supply is transformed down to 400 volts between phases, and to deal with the D.C. motors, a motor-transformer has been installed. The A.C. motors are squirrel-cage throughout, provided with star-delta starters. The D.C. motors are provided with regulating gear for varying the speed in accordance with the requirements of the driven machines. The motors have been supplied by the General Electric Co., Siemens Bros., and the British Westinghouse Co., and the work has been carried out in accordance with the specifications of Messrs. Lacey & Sillar.

Production of Mica.—The total value of the mica produced in the United States in 1910 amounted to $337,097. The production of sheet mica amounted to 2,476,190 lb., valued at $283,832, and that of scrap mica amounted to 4,065 tons, valued at $53,265. The electrical industry consumes by far the greatest part of the sheet mica produced.—*Electrical World.*

Annual Outings.—The sixth annual outing of the Armordnct Co. took place on Saturday last, when the head office staff, accompanied by some of the branch managers and agents—a party over 50 strong—assembled at Kingston, boarded the launch *King*, and proceeded up river to Staines, luncheon being served *en route*. On arrival the party separated to find amusements in punting and other pastimes. The return was made soon after 4 o'clock, tea being provided on board. At night the company assembled for an excellent dinner at Nuthall's Hotel, and music and singing concluded a most enjoyable day. Mr. Schmahl, in expressing his congratulations on the success of the outing, said it was gratifying to note the good feeling which existed between the executive and staff, he hoped they would continue in their determination to do whatever they had to do with success.

The annual outing of the employés of Messrs. Stegmann & Co., of Clapham Junction, took place on 15th inst., the party going to Margate. Good weather prevailed, and an excellent dinner and tea at the Royal Albion Hotel contributed greatly to the enjoyment of the trip, which concluded about 12 o'clock, midnight.

The staff of the Guildford Electricity Supply Co., Ltd., held their annual outing on Monday, July 3rd, when a very enjoyable trip was made to Margate. The staff accompanied by Mr. H. L. Alderton (engineer and manager) and Mr. R. H. Piper (secretary) left Guildford at 7 a.m. and arrived at Margate soon after 10 a.m. A first-rate dinner was served at the Imperial Hotel, the staff being joined by several guests. The outing was voted to be one of the most enjoyable the staff had ever had.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. Robert E. Armstrong (of the Newcastle Electric Supply Co.) has been appointed charge shift engineer at the L.C.C. Greenwich generating station, at a salary of £250 per annum, rising to £300, subject to the usual medical examination.

Mr. H. E. Munday, shift engineer at the Canterbury Electricity Works, has been appointed junior assistant engineer at the Borough of Shrewsbury Electricity Works.

The Huddersfield T.C. has decided to increase the salary of Mr. J. W. Turner, the chief electrical assistant, from £185 to £200 per annum.

The Electricity Committee of the Keighley T.C. has recommended the Council to increase the salary of the borough electrical engineer from £250 to £300 per annum.

Tramway Officials.—The Exeter T.C. has again rejected the proposal to increase the salary of the tramway manager from £160 to £170 per annum. A similar decision some time ago was on the ground that the increase was too small.

General.—Mr. J. H. West, works manager of the British Aluminium Co.'s factory at Stangfjord, Norway, is leaving the company to take over the management of the Havre works of la Société Anonyme Westinghouse. On the occasion of his leaving Stangfjord, Mr. West was presented by the workmen and staff with a handsome set of fittings for a writing table in Norwegian silver.

Mr. J. W. Speight, electrical engineer, of St. Annes-on-the-Sea, was cycling from Bispham the other day when he had the misfortune to be run down by a vehicle. His knee was rather badly wrenched.

Mr. J. Aked, manager of the Keighley district of the National Telephone Co., has been appointed manager of the Blackpool district, vice Mr. J. Tranter, who retires after 26 years' service, and will be succeeded by Mr. C. Gate, of Gateshead.

Mr. H. B. Tilley, well known in the Manchester district as the manager of Messrs. Bruce Peebles's office in that city, has just left this country for an extended business tour in Canada on behalf of his firm. Mr. Tilley will visit all places of importance in the Dominion, and expects to be away for fully a year. His many friends will, we know, wish him every success, and in due course a safe return home.

Mr. Gerald Hooghwinkel, of Messrs. Hooghwinkel, Anthony Brown & Partners, and director of the San Luis (Mexico) Tramways, Ltd., is leaving for Mexico and Cuba on the 29th inst. on professional business, and also to prepare for the electrification of the above company's lines.

NEW COMPANIES REGISTERED.

C. S. Wilson & Co., Ltd. (116,870).—This company was registered on July 18th, with a capital of £5,000 in £1 shares, to carry on the business of manufacturing, supplying and laying "Litosilo" and other compositions, engineers, electricians, &c., to acquire the business carried on by G. Harding, at Liverpool, as "C. S. Wilson & Co." The subscribers (with one share each) are:—G. Harding, 80-84, Regent Road, Liverpool, manufacturer; R. J. Graham, 84, Regent Road, Liverpool, secretary; J. McIntyre, 84, Regent Road, Liverpool, clerk; E. Griffiths, 84, Regent Road, Liverpool, clerk. Private company. G. Harding is managing director while holding 50 shares. Registered by T. T. Hull & Son, 22, Chancery Lane, W.C.

London and Mexico Concessions Syndicate, Ltd. (116,939)—Registered July 21st, by G. Reiche, 3, Lombard Street, E.C. Capital £20,000, in 18,000 ordinary shares of £1 each, and 40,000 deferred shares of 1s. each. Objects: To apply for, or acquire and turn to account, powers for the construction and operation of railways, tramways, telegraphs, telephones, harbours, quays, docks and sanitary, irrigation, gas, electric light and power, and other public works, &c., and to carry on the business of miners, traders, explorers, financiers, &c., in relation to Mexico, Great Britain, Africa, Australia, Canada, any British Colony or Dependency, North and South America, Japan, China and Europe. The subscribers (with one share each) are:—J. Colyton, Stanley Villas, Peidley Manor, Tring, gentleman; J. Yarwood, 21, Wolverton Gardens, Hammersmith, W., manager of motor company. Private company. The number of directors is not to be less than two or more than seven; the subscribers are to appoint the first. Registered office, 3, Lombard Street, E.C.

San Luis (Mexico) Tramways, Ltd. (116,808).—This company was registered on July 18th, with a capital of £150,000 in £1 shares (25,000 preference), to construct, purchase, lease or otherwise acquire, sell, grant leases of or otherwise dispose of, use or work any tramways, railways or any running powers, licences, rights or easements over or interests in the same, to generate, purchase and supply electricity, &c. The subscribers (with one share each) are:—R. C. Howley, 11, St. Ann's Road, Leytonstone, clerk; W. H. Morgan, 70, Park Lane, Clissold Park, N., clerk; P. M. Cullen, Revidge, Blandford Road, St. Albans, clerk; P. H. Wiggins, 141, Station Road, Church End, Finchley, clerk; S. H. Penwarden, 36, Peterborough Road, Leyton, clerk; A. A. Amos, 285, Lea Bridge Road, Leyton, clerk; W. H. Walford, 239, Mortlake Road, Ilford, Essex, clerk. Minimum cash subscription, seven shares. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, £200; remuneration, £150 each per annum (£50 extra for the chairman) and a percentage of the profits. Registered by Ashurst Morris, Crisp & Co., 17, Throgmorton Avenue, E.C.

Aldeburgh Electric Supply Co., Ltd. (116,867).—This company was registered on July 18th, with a capital of £7,000 in £1 shares, to manufacture and supply electricity in Aldeburgh, Suffolk and neighbourhood, and to adopt an agreement with Christy Bros. & Co., Ltd. The subscribers are W. H. Hall, Albert House, Aldeburgh, J.P., 100 shares; G. O. Knowles, Kenilworth, Aldeburgh, builder, 100 shares; W. Hill, Crabbes House, Aldeburgh, draper, 100 shares; L. F. Christy, 51, Broomfield Road, Chelmsford, electrical engineer, 100 shares; Sir Fredk. E. S. Adair, Bt., J.P., Flixton Hall, Bungay and Aldeburgh, 300 shares; F. C. U. V. Wentworth, Black Heath, Saxmundham, Com. R.N., 200 shares; F. Christy, 53, Bloomfield Road, Chelmsford, electrical engineer, 100 shares. Minimum cash subscription 2,000 shares; the number of directors is not to be less than three or more than seven; the first are W. H. Hall, G. O. Knowles, W. Hill, L. F. Christy and F. Christy; qualification, 100 shares; remuneration as fixed by the company. Office, 177, High Street, Aldeburgh.

Thomas Thorp & Co., Ltd. (116,961).—This company was registered on July 22nd, with a capital of £10,000 in £1 shares (3,000 preference), to take over the business carried on at Victoria Works, Besses-o'-th'-Barn, Whitefield, Lancs., as "Thomas Thorp & Co.," and to carry on the business of manufacturers of and dealers in gas, electric and water meters and scientific instruments, electricians, electrical, mechanical and civil engineers, &c. The subscribers (with one share each) are:—T. Thorp, Moss Bank, Whitefield, mechanical engineer; F. Thorp, Gasmere, Whitefield, mechanical engineer; H. T. Thorp, Moss Bank, Whitefield, mechanical engineer. Private company. The number of directors is not to be less than two or more than four; the first are T. Thorp, F. Thorp and H. T. Thorp; qualification, £100; remuneration as fixed by the company. Registered by Woodcock, Ryland & Parker, 15, Bloomsbury Square, W.C.

Alexander Harvey Exploitations, Ltd. (116,852).—This company was registered on July 17th, with a capital of £6,000 in £1 shares (1,000 ordinary and 5,000 "B"), to carry on the business of electricians, mechanical engineers, suppliers of electricity, &c., and to adopt an agreement with H. A. Harvey, G. P. M. Lee and C. A. Owen. The subscribers (with one share each) are:—C. Bowen, 25, Ely Place, Holborn Circus, E.C., solicitor; H. J. Turner, 25, Ely Place, Holborn Circus, E.C., clerk. Private company. The number of directors is not to be less than two or more than five; the first are H. A. Harvey, G. P. M. Lee, Q. Marino and C. A. Owen. Remuneration, £100 each per annum. Registered office, Norfolk House, Laurence Pountney Hill, E.C.

CITY NOTES.

United River Plate Telephone Co., Ltd.

THE annual meeting of this company was held on July 18th at Winchester House, E.C., Sir Irving Courtenay, Kt., M.A., presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, July 14th), said that the result of the year's operations was highly gratifying, especially when they remembered the droughts, locusts and other adverse influences which affected the prosperity of the Argentine generally. The business went on increasing, and the service was steadily improving. In August last they inaugurated a new common-battery board in the Avenida Exchange, their most important exchange in Buenos Ayres. The influence of that board on the service had been most marked, and warm congratulations on the improvement had been received. Two other exchanges transformed to the common-battery system were just on the point of being opened, while important extensions to three of the already existing common-battery exchanges had been carried out during the year, as well as extensions to several of the magneto exchanges. They had completed and opened a common-battery exchange in the Sunchales district of Rosario, and as soon as they could come to terms with the municipality of Rosario they hoped to install a full common-battery board in the central exchange in that city. In Bahia Blanca they had a common-battery board undergoing its final test before being put into operation, and there was very little doubt that one of their duties in the near future would be the joining up of that city to Buenos Ayres by means of trunk lines. The distance was not much short of 500 miles, and the operation would be a somewhat costly one, but as traffic between the two places was ever growing it could not be long delayed. Indeed, there appeared to be some probability that the Government would build large docks for warships in Bahia Blanca, and in that case communication with the Federal capital would be an absolute necessity. In the city of La Plata, the provincial capital of Buenos Ayres, they had been granted a concession to put their plant underground. That concession was only granted after several years of constant and strenuous effort. They had been much hampered in La Plata by the fact that the lines were aerial and liable to damage by every severe storm, and the plant was somewhat old-fashioned, but until they got the concession they were helpless to improve matters. Now, however, the necessary plans for a new board and building would be taken in hand; they had already got the underground conduits on the spot, and were collecting gangs to start work on that part of the undertaking. They were engaged in building a new line between La Plata and Buenos Ayres with creosoted pine poles carrying 20 circuits of different gauges to take both long and short-distance traffic, the extensions having been rendered necessary by the continual growth in the number of messages between La Plata and other parts of their system. The city of Cordoba was also claiming their attention; already they had plans prepared for a new building, and, as Cordoba was making splendid progress, a new and modern switchboard would before long be necessary. In some of the smaller towns they had had to enlarge their boards during the year as the number of subscribers increased, while they had opened up in several towns where they had not hitherto been established. In most cases these smaller towns were connected up to the nearest large town, while in other cases through and direct communication with Buenos Ayres had been necessary. They had been exceedingly busy during the year, in spite of the fact that their operations were considerably hindered at the end of last year and the beginning of the present year by a series of storms and floods quite unprecedented in their experience. In Buenos Ayres they had already installed 73 private branch exchanges, controlling 2,114 instruments through 265 exchange lines in banks, public offices and large business establishments; the convenience of them had appealed to the commercial community, and month by month they kept adding to the number with satisfactory results to all concerned. These private branch exchanges, too, afforded an opportunity of gradually introducing the message rate, which system of payment they hoped by and by to make universal, in the large cities at any rate. The extensions in hand and in contemplation necessitated fresh capital, and they proposed to make an immediate issue of 40,000 new ordinary shares, which as before would be offered to the ordinary shareholders at par. The reserve fund was increased by the amount of the appropriation of last year, and reserve for renewal of plant, &c., had also been increased, for they had this year charged direct to revenue the provision for renewal of plant, which hitherto they had only dealt with by means of an appropriation from profit. The expenditure on plant of all kinds was year by year expanding rapidly, and now the total expenditure in that account was £1,376,539. With regard to the profit and loss account, the figures showed increases in receipts and expenses in the Argentine of £64,885 and £60,658 respectively. At first sight it would look as if the expenditure had gone up out of proportion to the increased revenue, but that was explained by the fact that they had this year included their provision for the renewal of plant under the heading of "maintenance." In other respects the expenditure had been perfectly normal. The profit for the year was £129,854, as against £123,557 in the previous year. The chairman proceeded finally to refer to the proposal to vote £2,000 to the staff provident fund.

The CHAIRMAN then moved the adoption of the report, which was seconded by MR. F. GREEN. The retiring directors were re-elected, and the proceedings terminated with a vote of thanks to the chairman for presiding.

Metropolitan Railway Co.

THE report of the directors shows that the total receipts for the half-year ending June 30th, 1911, amount to £400,735 and the expenses to £195,666, leaving a profit of £205,069. Compared with the corresponding half-year of 1910 the receipts show an increase of £9,247 and the expenses an increase of £1,646. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges and placing £5,000 to the electrical renewal and depreciation fund, shows a balance of £166,728, which will permit of the payment of the dividends upon the preference stocks, and leave a balance of £61,424 available for dividend upon the ordinary stock. The directors recommend the proprietors to declare a dividend upon the ordinary stock for the past half-year at the rate of £2 per cent. per annum, and to carry forward the balance of £4,104 to the next half-year's accounts. This compares with £1 5s. per cent. for the corresponding period of 1910, when the carry forward was £6,044. The passenger traffic of the railway maintains a steady development, notwithstanding keen competition. During the half-year further improvements have been made in the train services on the various sections of the line, and more "non-stop" trains have been introduced during the busy hours of the morning and evening. The result has been a considerable increase in the issue of season tickets. The parcels and goods traffic continues to show a satisfactory expansion. The Bill promoted by the company in the present session of Parliament is expected to receive the Royal Assent at an early date. The directors propose to avail themselves without delay of the provisions of this Bill empowering the issue of stock certificates to bearer where such certificates are desired by stockholders. Clauses for the protection of this company have been inserted in Bills promoted by the London Electric and Central London Railway Companies. The London County Council included in their Bill of this session a scheme for constructing a tramway from

Cricklewood to the Marble Arch, which was opposed by this company, and ultimately struck out of the Bill. The installation of automatic signalling between Willesden Green and Neasden has now been completed. The replacement of the existing electrical plant at Neasden by machines of larger capacity and improved economy is proceeding satisfactorily. The work of widening the tunnel and approach to Baker Street (East) Station from the north is being rapidly pushed forward. Additional contracts for carrying out further portions of the scheme for the improvement of Baker Street Station have been let, and the works are proceeding. Arrangements for the electrification of the East London Railway are engaging the special attention of the lessee companies, and the work is expected to be put in hand shortly. Its completion will permit of this company's train service over that railway to New Cross being resumed. The directors regret to report the death of Sir William Birt, and desire to place on record their high appreciation of his valuable services to the company since his election to the board in 1902. The vacancy has been filled by the election of the Hon. Francis McLaren, M.P. The progress of the traffic carried on the railway since 1905 has been as follows :—

Year.	Number of passengers.	Gross receipts for passengers, goods, minerals and tolls.
1906	96,384,766	£681,268
1907	96,859,108	640,838
1908	99,846,735	680,357
1909	99,961,997	696,881
1910	102,849,458	718,089
1911 to June 30th	51,430,913	362,427

Report of Surplus Lands Committee for Half-year ending June 30th, 1911.

The rental accrued during the half-year amounts to £40,976 and the outgoings and expenses to £3,178, leaving, with the balance brought from last half-year, £39,845 available for dividend. This will admit of a dividend at the rate of £3 per cent. per annum upon the surplus lands stock, carrying forward a balance of £232. Twenty properties—nine private houses and 11 business premises—are vacant, representing £1,438 per annum in rental. This time last year the unlet properties were of the value of £1,392 per annum. The vacancy in the stockholders' representatives created by the death of Sir W. Birt has been filled by the appointment of Mr. Robert Hope Selbie, subject to confirmation at the ensuing half-yearly meeting.

Electric Construction Co., Ltd.

THE annual meeting of the shareholders of the above company was held on Thursday of last week at Winchester House, Old Broad Street, Mr. W. S. B. McLaren, M.P., presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, page 68), said he was pleased that the forecast of an increased demand for electrical machinery and of increased profit, which he ventured to make last year, had been fulfilled. They had not been engaged on contracts of any magnitude, but the number of machines supplied for industrial purposes at home had been greater than in any previous year. The result of the year's working was that they were able to recommend a modest dividend of 2½ per cent. on the ordinary shares—the first since 1904. It was a poor return for all the capital employed and all the skill and energy exercised in the conduct of the business, but it was something to find themselves once more in a position to recommend a dividend, however small. They had commenced the new financial year with a larger amount of work on hand than last year, and, as stated in the directors' report, they viewed the future with confidence, if the present demand were maintained. He wished to emphasise this condition, however, because the capacity for production at home had not diminished, nor had the keen competition among British and foreign manufacturers in all parts of the world relaxed. As indicated in the report, they had disposed of their holding of ordinary shares in the Madras tramways. Their holding in the tramway was now represented exclusively by 6 per cent. cumulative preference shares, and, as the traffic receipts were still developing, and the extensions (to which he referred last year) had now been sanctioned, their investment would yield a steady and satisfactory return. With part of the proceeds from the sale of these shares they had redeemed the remaining £10,000 second mortgage debenture stock and also £17,300 of first mortgage debenture stock. During the past two years, therefore, they had redeemed £67,300 of debenture stock, and the amount now outstanding was £182,700 only. The reduction had strengthened the financial position of the company, reduced the charge for interest, and established a more equitable relation between the amount of the mortgages and the amount of share capital issued. As he informed them last year, the whole of the stock redeemed would be kept alive for the purpose of re-issue, if required, but they did not expect this would be necessary. A net deficit of £18,827 arising out of the sale of the Madras tramway shares less the surplus on the redemption of debenture stock had been debited to general reserve fund; but he would remind them that the sum of £10,000 was credited to this fund last year out of the surplus arising from the redemption of the first portion of the second mortgage debenture stock, and, therefore, the net debit to general reserve fund for the whole series of transactions had been £8,827 only. They had always recognised that fund as a reserve against realisations of shares in other companies, and the sum of £25,000 which would remain at the credit of the fund, if they adopted their recommendations, was a very substantial reserve against reduced holdings, which now amounted to £73,331. He was pleased to be able to inform them that the judgment in their favour in the action brought against them by a German concern, for alleged infringement of a patent, was unanimously confirmed by the Court of Appeal. They had not heard whether the plaintiffs intended to prosecute the matter further. Turning to the profit and loss account, there was an increase in gross profits on manufacturing and contracting of £8,075. Interest and dividends received showed an apparent reduction of £434, due entirely to an alteration in the period for which one of the dividends had been calculated. On the other side of the account there was a reduction in debenture interest of £1,813, and an increase in general charges of £1,203, due chiefly to the increased volume of business transacted. In common with others, their investments showed some depreciation. They were entered this year at the market value, the sum of £277 having been written off.

In reply to a shareholder, he said they had preference shares of £1 each at par in the Madras Co. and also shares in the Electric Power Storage Co., which were valued at £55,000. Against that, in case they were sold at less than par, they had a general reserve fund of £25,000. Replying to another shareholder, the chairman said the Electric Power Storage Co. had passed their first dividend.

Anglo-American Telegraph Co., Ltd.

THE report of the directors states that the total receipts from January 1st to June 30th, 1911, including the balance of £2,609 brought forward from the last account, amounted to £191,455. The traffic receipts showed a decrease of £37,794, as compared with the half-year ended June 30th, 1910. The working expenses of the half-year, as shown by the revenue account, amounted to £76,980, being an increase of £1,328 as compared with the corresponding period of 1910. In addition, there were the expenses of negotiations with the Western Union Telegraph Co., for which a sum of £3,500 had been set aside. The agreement with the Western Union Telegraph Co. is settled in principle and in detail, but is not yet exchanged. It provides for a guarantee of £262,500 a year, payable quarterly, equal to 3¾ per cent. on the ordinary, 6 per cent. on the preferred and 1½ per cent. on the deferred stock. In these circumstances the board has decided to place £5,000 only to the renewal account for the half-year and to credit the interest on sundry securities to the revenue account, thus leaving a balance of £105,974. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on May 1st, 1911, absorbing £52,500, and second quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on August 1st, 1911. The balance of £974 will be carried forward to the next account.

Crompton & Co., Ltd.

IN their report to be presented at the annual general meeting on July 31st, the directors regret that the result of the year's trading, after the usual provision for depreciation, shows a loss of £14,195, as compared with £20,493 for the year ending March 31st, 1910. After providing for debenture interest and other charges shown in the net revenue account, the balance to the debit of this account is increased to £48,271. The margin of profit obtainable during the financial year on the sale of goods of the company's manufacture has been small, but the demand is steadily improving, and an increase in the turnover is all that is required to enable the company to earn satisfactory profits. Pending the realisation of certain retention moneys and other items which tended to lock up the working capital of the company, and which might otherwise have been used to develop the output at the company's works, the directors did not feel that they were warranted in permitting the works to hold so large a stock as in past years, and this reduction had adversely affected the output and the company's profits. The amount of capital so tied up is being gradually reduced, and it is anticipated that further sums will shortly be realised which will be employed for the benefit of the company's business, and this should materially improve the position. The necessary structural alterations at the company's works, to accommodate the headquarters of the sales department, were completed in December last, and the past year's accounts, which had to bear the cost of removal, benefit but little by the saving in expense now being effected. Mr. Lionel H. Hanbury retires from the board by rotation, but offers himself for re-election. Lieut.-Col. John Clibborn, C.I.E., has been appointed to a seat on the board, which appointment requires the confirmation of the shareholders.

Liverpool Overhead Railway Co.—The directors recommend payment of dividends at the rate of 5 per cent. per annum (the same as last year) on the preference shares, and 1 per cent. per annum on the ordinary shares (on which no dividend was paid in 1910), leaving a balance of £4,665 to be carried forward.

Chelsea Electricity Supply Co., Ltd.—The directors have declared an interim dividend at the rate of 4 per cent. per annum (2s. per share) on the ordinary shares for the half-year to June 30th, being the same as last year.

Vickers, Ltd.—The directors have declared an interim dividend for the half-year ended June 30th last of 1s. each on the ordinary shares, free of income-tax; the same dividend was paid last year.

Lanarkshire Tramways Co.

THE directors report that the result of the half-year's working was as follows:—Revenue £36,532, expenses £19,359, leaving £17,172, from which are deducted contributions payable to local authorities £878, interest on debentures £673, interest account £614, leaving £15,006. The balance brought forward from December 31st, 1910, was £1,499, and the directors recommend a dividend at the rate of 5½ per cent. per annum for the half-year on the issued share capital £9,432, and the carrying forward of £7,073 to revenue new account. The traffic receipts for the half-year show an increase of £320 and the expenses a decrease of £1,240, as compared with the receipts and expenses for the corresponding half-year of 1910, the saving in expenses being mainly on permanent way and overhead line repairs and third party accident claims. The application to Parliament for an extension of time order, referred to in the last report, was withdrawn owing to the action of the Lanark County Council regarding the non-completion of the authorised lines. The expenses of the Bill, amounting to about £450, will be written off. It was decided to proceed with the extension to New Stevenston, as this can be completed before the powers lapse in August next, but the extensions to Bellshill and Mossend cannot be proceeded with. The New Stevenston extension will be completed and opened for public traffic early in August. Towards the cost of this extension 4 per cent. debentures of £50 each were offered to the shareholders in June at £47 10s. per debenture. Four additional cars have been ordered and will be put into service shortly. The directors will, as usual, provide for depreciation when the final accounts are made up at the end of the year. The following details relate to the last two years' working:—

Half-year ended—	Miles open.	Passengers carried.	Traffic receipts.	Car-mileage.
December 31st, 1909 ..	21·28	6,896,172	£35,887	936,238
June 30th, 1910	21·28	6,926,878	35,691	890,689
December 31st, 1910 ..	21·28	7,206,852	37,226	907,632
June 30th, 1911..	21·28	7,074,121	36,001	885,322

Marconi's Wireless Telegraph Co., Ltd.

THE annual meeting of the shareholders of this company was held on Thursday last week at the Hotel Metropole, Commendatore G. Marconi, LL.D., D.Sc., in the chair.

In proposing the adoption of the report (see ELECTRICAL REVIEW, page 69), the CHAIRMAN said that at the last meeting he told them that in view of the general development of their business there was good reason to expect that not only would the preference shareholders be able to look in the future for regular payment of their dividend, but that the ordinary shareholders might also expect to receive very shortly some return upon their investments. Examination of the balance sheet justified what he said on that occasion. It was a matter of considerable satisfaction to the board to have been able to place before them accounts which showed so marked an improvement in the profit and loss account as compared with the preceding year. Looking to the figures, they would find on the credit side of the profit and loss account the sum of £127,452 under the heading "by balance of contract and trading account," which figure in itself showed the magnificent progress of the business. They had informed them in the report that it had not been considered prudent to continue to set out in the future the figures of the profit and loss account in the same form as they were submitted last year. There was no hidden mystery in their decision in this matter; their object was merely to avoid giving to those who were not interested in the company information which it were better they were without. At the same time they did not think they were keeping from the shareholders anything which they had any interest in knowing, other than, perhaps, the amount of the gross sales, and it was exactly this which they did not propose to make public. The accounts were treated in the books in exactly the same way as they were last year, and no profits were taken into consideration on account of contracts which were in course of completion. In order to avoid any possible misunderstanding, he wished to say there was no truth in the suggestions which had been made that the balance of contracts and trading account embraced any sums received by way of compensation resulting from the patent action, nor did the figure include the dividends declared by the associated companies, to which they had made reference in the report. In the first instance, it was scarcely necessary, perhaps to remind them that the judgment in the action was only given towards the end of February last, and the dividends of the associated companies were declared and paid during this year, whereas their accounts for 1910 were closed on December 31st of that year. The trans-Atlantic service, which was opened in April last year, continued to work very satisfactorily, particularly in so far as the wireless operation of the service was concerned. They had had, and continued to have, some trouble owing to the mutilation of code words by the landlines, which, they regretted to say, applied more to this country than it did to the other side. They had arrangements in view which would eliminate this trouble; their programme, however, in this direction must be subject to circumstances. A satisfactory solution would be the continuance of their wireless service into London, provided the necessary licence could be obtained from the Post Office. In view, however, of the Government programme in connection with wireless telegraphy, they felt that this question must stand in abeyance for the present. The difficulty to which they had referred did not arise with plain English messages; these the Post Office operators seemed able to handle very efficiently. It was, therefore, probable, subject to negotiations pending, that at an early date they would carry into effect their intention of accepting plain English messages at a rate of 4d. per word. By adopting this course, they thought a great many messages now sent by code at the higher rate would be sent in plain English, and at 4d. per word they would be just as profitable to them, and certainly more satisfactorily handled than code messages at 7½d. He was engaged at the present time in making the necessary arrangements at the Clifden Station for the introduction of their new duplex system, and so soon as these arrangements were completed, and in the very early future, he was proposing to proceed to Canada to similarly install their Glacé Bay Station. When this was done, their service would be materially improved, and its capacity at least doubled a with very small increase of running expenses. Amongst the large amount of work which had been completed during the past year was the construction of two stations in Brazil for the Madeira Mamore Railway Co., thus putting Porto Velho into radio-telegraphic communication with Manaos. He made particular mention of these stations as an indication of the probable adoption of wireless telegraphy in undeveloped countries for the commercial telegraph service of the future in place of land-lines. During the year under review a number of important contracts were entered into, which included the erection of stations in Italy, Turkey, Greece, Spain and the Canary Islands. The station of the Italian Government at Coltano would be inaugurated this autumn, and would enable communication to be carried out between Italy and North America, and probably also with Great Britain, Spain, Turkey and Greece. A first agreement was made with the Eastern Extension Telegraph Co. for the erection of a coast station at Cocos Island for the purpose of maritime communication, which station would be worked on the joint account of the Cable Co. and themselves. This was the first of a series of coast stations extending to Hong Kong, Singapore, Malta and Gibraltar, to be erected under similar conditions. These should materially assist their international maritime business. Important negotiations had been carried on with the French Government, which had since resulted in the completion of a working arrangement between the French Government and the affiliated Marconi Companies. They had designed several types of portable apparatus for military purposes, and business of a substantial nature was resulting therefrom. A Press agency had been organised upon the high seas, enabling them to receive and distribute any news of importance occurring on board ship or coming within the knowledge of ships upon the ocean. During the early part of the year under review they submitted to His Majesty's Government a scheme to put all the British Possessions into wireless communication with each other, and applied for a concession for the erection and working of the necessary stations. From this would appear to have developed the Imperial wireless scheme introduced by Sir Joseph Ward at the recent Imperial Conference. They would have preferred to have carried out the scheme they had proposed; there were, however, reasons which they were quite able to appreciate why the Government should prefer to take this scheme in hand themselves under a working arrangement with the company. They would, however, be equally satisfied if their negotiations eventually resulted in their erecting the stations on behalf of the Government upon terms which would compensate the company for the large sums of money and the immense amount of work which it had devoted to the development of long-distance commercial wireless telegraphy. They were satisfied that the Government recognised that it was solely due to the company's patents, and to the experience and knowledge which it had obtained through its work in connection with its commercial operation of the trans-Atlantic service, that the Imperial scheme had come within practical politics. It was well to point out that no company other than theirs had been able to erect stations for the purpose of long-distance commercial radio-telegraphy; all that had been done by others in this direction had been of an elementary experimental nature. They were aware that during last year he travelled to Buenos Ayres, experimenting on the way with their Clifden and Glacé Bay stations; they were successful at different distances, and right up to his arrival at Buenos Ayres, in receiving messages from both stations at a distance of over 6,000 miles. Their Argentine company would now proceed with the erection of its long-distance station, which should put South America into commercial wireless communication with Europe. They were engaged in active negotiations with foreign Governments for the erection of other long-distance wireless telegraph stations in countries outside the British Empire, which stations would either be worked by them, or they would remain interested in the working of them. The policy of the board was to erect long-distance commercial wireless telegraph stations throughout the world, and to remain interested in the working of them. The judgment obtained against the British Radio-Telegraph and Telephone Co. had materially strengthened the position of their company. They were, no doubt, all aware that it was an action brought by them for infringement of the patent which was known as the "four-sevens" patent, and which embraced syntonisation. The more important commercial development of wireless telegraphy—especially in regard to long distance—dated from this patent, and he did not know of any commercially useful system of wireless telegraphy to-day which did not infringe it. They had informed them in the report that it was their intention to protect their rights throughout the world. Their financial position to-day enabled them to set aside a substantial sum of money for this purpose, and it was a policy which they intended vigorously to pursue wherever it might be desirable and necessary. He regretted that after the report was drafted, they found it incumbent upon them to issue a writ for infringement of patent against the Lodge-Muirhead Wireless and General Telegraphy Syndicate, Ltd., who had in turn retaliated by issuing a writ against them. It had been suggested to them that an arrangement might be made which would have obviated the necessity of their taking legal proceedings, and they

accordingly for a time deferred taking any action. It would be his pleasure to submit for their approval the payment of the cumulative 7 per cent. dividend upon the preference shares to the end of December, 1910, and to declare an interim dividend upon the preference shares for the half-year ending June 30th at the rate of 7 per cent. per annum. He would then have the pleasure of declaring for the first time in the history of the company a dividend upon the ordinary shares. The board was unanimous in contenting itself for the present with the declaration of an interim dividend upon the ordinary shares for the six months ending June 30th, 1911, at the rate of 10 per cent. per annum. In conclusion, the Chairman referred to the loyal and untiring support which they had received from the whole of the staff, and remarked that there had been periods in the history of the company when they were struggling with very great difficulties, when the staff not only stood loyally by them, but generously agreed to accept reductions in their salaries. Having now emerged from these difficult and unprofitable times, they desired, and he was sure they would have the approval of the whole of the shareholders, to mark more particularly their appreciation of their work and consideration by allocating to them from the profit and loss account a reasonable bonus, which should be left to the discretion of the board, for distribution amongst them.

Mr. Godfrey C. Isaacs, in seconding the motion, referred to the remarks of the chairman regarding their patent action and to their four-sevens patent. He said he had been frequently asked of late what would be their position when this patent matured. In the first instance, before that time arrived they would have built up a big and staple business, but in any case he was advised and believed that for so important an invention they would have no difficulty in obtaining a substantial extension of their patent; but their four-sevens patent was only a part—true, an important part, but nevertheless only a part—of their system of wireless telegraphy. The whole consisted of this and a number of other patents of importance, and to these Mr. Marconi added improvements year by year. They had an excellent example of this in the new duplex system. Who would be satisfied to-morrow with their four-sevens and other patents, or with any other system of wireless telegraphy, if the duplex, which doubled capacity, were not included?

The report was adopted.

Consolidated Electrical Co., Ltd.

The report of the directors for the year ending March 31st, 1911, states that the ordinary income for the period under review amounted to £5,477, in comparison with £5,760 for the previous financial year. The figures for the preceding year included a sum of £287 for interest receivable from the Consolidated Supply Co., Ltd. The general charges for the year amounted to £1,279, in comparison with £1,331 for the preceding 12 months. Of the balance of £6,261 standing to the credit of revenue account, the interim dividend of 3 per cent. paid on the preference shares on January 1st, 1911, absorbed £450, leaving a disposable balance of £5,811. The final dividend of 3 per cent. paid on the preference shares on July 1st absorbed a further £450, and the directors now recommended the payment of a dividend on the ordinary shares of 3½ per cent., free of income-tax, for the year ending March 31st, 1911. This will absorb £3,850, and leave a balance of £1,511 to be carried forward. The directors are satisfied that the valuation placed upon the company's investments in the balance-sheet is well within their intrinsic and realisable worth; the position of the Anglo-Portuguese Telephone Co. continues entirely satisfactory. The director retiring is Mr. Charles Woolley, who offers himself for re-election.

Mr. Herbert Allen (chairman) presided on Thursday last week at River Plate House, E.C., over the ninth ordinary general meeting of the company.

In moving the adoption of the above report, the Chairman said it was on the usual humdrum form, and practically the only alteration from last year was in the paragraph relating to dividend, which they were now paying for the first time free of income-tax; on several occasions shareholders had suggested that this should be done, and in a rash moment last year he promised that it should. He supposed that in these days of heavy income-tax it made the 3½ per cent. dividend equivalent to 3¾ per cent., or something like that. In the balance-sheet their liabilities were unchanged. Sundry creditors showed a slight increase, which was due to a temporary loan, repaid since the report was printed. On the other side, the three tangible assets of the company were the investments, the revenue suspense account and the cash at the bank, and these represented more than the figure given in the accounts. To all intents and purposes they were now a single investment trust company. The investment they held was in the Anglo-Portuguese Telephone Co., and beyond that they had practically nothing. Last year they set out the securities of the Consolidated Supply Co., but as they were worth practically nothing, they had eliminated that item from the accounts, as it might mislead shareholders. The item of investments, which comprised 72,000 shares in the Anglo-Portuguese Telephone Co., was put down at £81,000, which was about 22s. 6d. a share, and, as a matter of fact, that was well within not only their intrinsic value, but their realisable value, so that the investment was under rather than over-estimated. The Private Wiring and Installation Co. had been got rid of altogether, and the Consolidated Supply Co. was, to all intents and purposes, done with. It had not yet actually been wound up, but they hoped it would be before long, and in the meantime they were incurring no further responsibility in connection with it. They had not let it have any money for several years, and what they were aiming at was that, in the process of winding up, they were not saddled with any obligation or responsibilities. When those companies were finally out of the way, they might then be able to bring up a scheme for dealing with the remaining asset of the company. The item of dividends, received, &c., was smaller by about £300, owing to the fact that they had not included certain interest from the Consolidated Supply Co. which they knew they would not get.

Mr. C. Woolley seconded the motion.

Mr. Weddrell urged that the board should wind up the Consolidated Supply Co. as quickly as possible, and then they might divide the shares of the Anglo-Portuguese Telephone Co. amongst the shareholders of the Consolidated Electrical Co. and wind that up. He estimated that if this was done and he received one share in the Anglo-Portuguese Co. for two shares in the Consolidated he would get 4 per cent. instead of 3½ per cent.

Mr. Riverton hoped they would have the assurance that the company would not lend any more money. He also thought that if they divided up the Anglo-Portuguese Co.'s shares and wound that company up they would get 5 per cent. on their money.

The Chairman, in reply, said that it was the intention of the board at the first favourable opportunity to realise the Anglo-Portuguese shares and distribute the assets, but the present was not an opportune time.

A Shareholder pointed out that the shares could be divided.

The Chairman said he thought it would be far more advantageous for the shareholders to realise the holding *en bloc* and then distribute the cash. It was not a case of giving one Portuguese share for two Consolidated shares, and there were the preference shareholders and the creditors to deal with first. The delay which occurred in winding up the Consolidated Supply Co. was due to the fact that they had the factory at Canonbury on a long lease, which they were trying to dispose of. The factory was let, and threw no cost on the company.

The report was then adopted, and the retiring director re-elected.

Mersey Railway Co.

The report of the directors for the half-year ended June 30th, 1911, states that the train-mileage run during the half-year was 326,063 miles, as compared with 330,307 during the corresponding six months of 1910. The number of passengers conveyed during the half-year ended June 30th, 1911, has been 6,027,753, as against 5,948,152 for the corresponding period of 1910, exclusive of season-ticket holders. The total receipts from all sources for the half-year have been £55,796, as compared with £54,653 for the corresponding period of 1910. The working expenses, exclusive of the charges for pumping, ventilation and lifts, have been £26,426, equal to 47·36 per cent., as against £28,916, equal to 52·91 per cent. for the corresponding six months. These charges for pumping, ventilation, and hydraulic lifts for the past half-year amounted to £2,798, equal to 5·01 per cent., as compared with £3,279, or at the rate of 6·0 per cent. for the corresponding period of 1910. In accordance with the provisions of the Mersey Railway Act, 1910, the sum of £5,005 standing at the debit of the net revenue account at the close of the half-year ending December 31st, 1910, has during the half-year been transferred and charged to the capital account of the company. After providing for rent charges, renewal fund and interest on the new first perpetual debenture stock, there is a balance at the credit of the net revenue account of £8,061, which has been carried forward to the next half-yearly account to be applied so far as available therefor, after December 31st, towards payment of interest on the debenture stocks, which are contingent on the revenue available therefor in each separate year ending December 31st.

Stock Exchange Notices.—The Stock Exchange Committee has appointed a special settling day as under:—

August 3rd.—Metropolitan District and London Electric Railways.—Speyer Bros.' scrip certificates, fully and partly paid, for £1,538,700 joint power house rent charge stock.

And ordered the undermentioned securities to be quoted in the Official List:—

Bell Telephone Co. of Canada.—$4,899,000 5 per cent. bonds, 1925, Nos. 801 to 900, 1,201 to 1,800, 3,801 to 4,800, and 7,151 to 7,650 of $500, and Nos. 1 to 800, 901 to 1,200, 1,801 to 3,749, 4,901 to 5,500, and 6,001 to 6,400 of $1,000 each.

British Columbia Electric Railway Co.—Further issue of £200,000 deferred ordinary stock; £200,000 preferred ordinary stock; and £200,000 5 per cent. cumulative perpetual preference stock.

Metropolitan District and London Electric Railways.—Speyer Bros.' scrip certificates, partly paid, for £1,538,700 joint power house rent charge stock.

Mexico Tramways Co.—$5,664,200 additional common stock in shares of $100 each.

South American Light and Power Co., Ltd.—According to the *Financial Times*, the net profit for the year ended March last is £9,478, which, added to £558 brought forward, makes a total sum available of £10,036. The directors recommend a dividend of 5 per cent. and also the payment of interest at the rate of 5 per cent. per annum on the £71,380 capital expenditure incurred during the year by the railway company, leaving a balance of £1,079, out of which it is proposed to place £500 to reserve, and to carry forward £579.

County of London Electric Supply Co., Ltd.—The directors have declared an interim dividend for the half-year ended June 30th, 1911, on the ordinary shares at the rate of 4 per cent. per annum, less income-tax, being the same as last year.

Bombay Electric Supply and Tramways Co., Ltd.

THE directors' report for the year ended December 31st, 1910, shows a total revenue for the year amounting to £219,317, being an increase of £21,489 over the previous year. The total expenditure amounted to £122,139, being an increase of £7,007 compared with the previous year; the net receipts were £97,177, an increase of £14,482. After deducting £32,383, the proportion of debenture interest chargeable to revenue, and £629, appropriated to sinking fund in lieu of interest on debenture stock cancelled in 1909 and 1910, there remained £64,164, to which is added the amount brought forward from last year, £4,567, making an available total of £68,731. From this has to be deducted the dividend on the 6 per cent. cumulative preference shares paid to August 15th, 1910, £22,489, also the dividend on the 6 per cent. cumulative preference shares accrued to December 31st, 1910, £13,493, leaving a balance of £32,748. The directors recommend that this sum should be applied as follows: Depreciation account, £15,000; sinking fund for capital redemption, £6,000, and carried forward to next account, £11,748. In accordance with the method adopted last year, the directors propose, in regard to the above-mentioned £15,000 to be placed to depreciation account, to invest the sum of £10,000 outside the business.

The tramway traffic receipts amounted to £144,182, compared with £134,153 for the previous year. The working expenses in Bombay amounted to £73,488, compared with £70,596 for the previous year. The balance of receipts over expenses in respect of the year's working is £73,222, compared with £65,918 for the previous year. The following statistics relate to the tramways:—

	Year ended Dec. 31st, 1909.	1910.
Miles opened—Route miles..	20·38	20·38
Number of passengers carried	32,210,468	34,163,079
Proportion of expenses to receipts ..	51·7 %	50 %
Number of cars in stock—electric.. ..	172	178

The gross receipts from electric supply for the year, including the amount represented by the sale of current to the tramways, amount to £66,921, compared with £57,552 for the preceding year. The receipts, exclusive of the revenue represented by the current supplied for the tramways, amount to £37,043, compared with £31,493 for 1909. The working expenses were £43,897, against £40,934 for the previous year. The balance of £23,024, as the result of the year's operations, compares with a balance of £16,618 for 1909. The following figures show the comparative results for the past five years:—

Year ended Dec.	No. of consumers.	Units sold.	Revenue.	Expenses.
1906	330	531,731	£8,435	£10,075
1907	588	2,056,907	21,566	19,545
1908	803	5,263,630	47,714	39,737
1909	1,084	6,253,112	57,552	40,934
1910	1,494	7,296,856	66,921	43,897

The Bombay Municipal Corporation has agreed to a tariff of flat rate charges for the supply of electrical energy to all consumers, except for industrial motive power purposes, in substitution for the maximum demand system heretofore in force.

The capital expenditure during the year in connection with the construction of the new Kussara power station, on new mains and the development otherwise of the supply of electricity for lighting and power, and the further equipment and improvement of the tramways, has amounted to £129,882. Debenture stock to the amount of £5,300 was bought and cancelled last year under the operation of the sinking fund, reducing the amount outstanding on December 31st to £588,323. Since the close of the financial year arrangements have been made for the sale of a further £50,000 5 per cent. second mortgage debentures, to provide for the expenditure in connection with the new power station, the extension of the supply mains, and additional rolling stock. Sir Edward Sassoon and Mr. F. W. Chanter are the directors retiring by rotation, and, being eligible, offer themselves for re-election.

The sixth ordinary general meeting of the above company was held on Wednesday at the Electrical Federation Offices, Kingsway, Sir Charles Ollivant, K.C.I.E., presiding.

The CHAIRMAN, in moving the adoption of the report, said that the net receipts resulting from the past year's operations, amounted to £97,178, compared with £82,696 for the previous year, being an increase of £14,462. After deducting debenture interest amounting to £33,013, there remained the sum of £64,164, to which had to be added £4,567 brought forward from the previous year, making an available total of £68,731. Of this amount, £35,983 was required for the dividend paid on the preference shares to August 15th last, and for the proportion of dividend accrued to December 31st last, leaving a balance of £32,748, which the directors recommended should be dealt with by placing £15,000 to depreciation, £6,000 to sinking fund, and carrying forward £11,748. The total revenue from all sources, including the amount represented by sale of current to the tramways, amounted during the year to £219,317, an increase of £21,489 over the revenue of the previous year, which additional revenue was earned by the further expenditure of only £7,007. The increased revenue derived from the working of the tramways, provided them with £10,197 of the gross increase, and £9,369 was attributable to increased receipts in the electricity supply branch. At the last general meeting allusion was made to the depression then existing in the mill industry, and to its retarding effect upon the progress of their traffic receipts. He was unable to say as yet that this depression had passed away. The past year was described by the president of the Bombay Millowners' Association, at their recent annual meeting, as having been one of the most unfortunate ones in the history of the Bombay cotton industry. A large number of the mills had suspended work, and several others have been working half time, with the result, as estimated, that about 30,000 people have been thrown out of employment. There could be no doubt that the closing of so many mills had adversely affected their traffic receipts both last year and this. The board, nevertheless, felt that they were justified in regarding as decidedly satisfactory the further improved results in the working of the tramways, which, notwithstanding these adverse circumstances, had been achieved—viz, an increased net return of £7,364, and which continued to be maintained. In order to meet the demand for increasing travelling facilities the directors have found it necessary to further augment the company's rolling stock by the addition of 12 more cars. Turning to the balance-sheet, the capital expenditure during the year amounted to £129,882. Of this amount, £115,817 represented expenditure in the electricity supply branch, called for chiefly in connection with the construction of the new power house at Kussara and on new mains for the development of the electricity supply business. During the current year, further heavy expenditure had been necessary for these purposes, which had been met from funds already in hand and temporarily invested, and by the issue of a further £50,000 of second mortgage debentures. In connection with the approaching Royal visit to India, the directors had made a contribution of 5,000 rupees to the Celebration Fund. They would be pleased to hear that the arrangements for illuminating the principal public buildings in Bombay had been entrusted to the company. With regard to the Bombay Hydro-Electric Power Co., whose works were now in active progress, so far from there being risk of injurious competition between the two companies in their respective spheres of activity, they were much more likely to derive benefit from mutual assistance and friendly co-operation. He thought that the report gave them facts which encouraged the hope that their position by the time they next met might be such as to justify the payment of a dividend on the ordinary shares, if only on a modest scale. He might for their convenience summarise the revenue outlook as follows:—The net receipts after providing for working and administration expenses were £94,000, and this sum just sufficed for interest on the first and second debentures, including in the latter £50,000 still to be taken up, for the sinking fund and depreciation assignment, and for the dividend on the preference shares. But as they had seen, they carried forward nearly £12,000, and the profit on this year's working over that of the previous year, £14,000, was, roughly speaking, equally divided between the older and younger branches of the undertaking. This showed that the older, the tramways, had a healthy capacity for further development, and that the younger (supply for lighting and power) was making speedy and vigorous progress. The sums carried to profit and loss account for the last four years successively had been as follows (in round figures) £2,000, £8,000, £15,000, £23,000.

The resolution was seconded and carried unanimously.

MR. CURRY, a shareholder, asked why they borrowed money at 5 per cent. on second debentures, and then bought 3½ per cent. securities with the money.

The ASSISTANT SECRETARY said that the money was borrowed at 5 per cent., but they took the best care they could, and invested it where there was greatest security.

MR. CURRY said that it was always possible to get 4 per cent.

The CHAIRMAN said it was invested in Government securities, and they had been fortunate enough to secure a profit of about 4 per cent. in all. There being 3 per cent. in the first instance, and another 1 per cent. on the deal.

After the retiring directors had been re-appointed, and the auditors had been re-elected, a vote of thanks to the chairman concluded the meeting.

City and South London Railway Co.

THE fifty-fourth half-yearly meeting of the shareholders of the above company was held on Tuesday at the offices, 71, Finsbury Pavement, the Right Hon. C. B. Stuart Wortley, K.C., M.P., presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 104), said they met after a record half-year, in which they had carried more passengers than ever, and more passengers per train (126·6). As against the first half of 1910 they showed increased receipts per train (17s. 11·84d., against 17s. 4·2d.), also increased receipts per train-mile (2s. 5·41d., against 2s. 4·37d.), and a decreased percentage of working expenses to receipts (45·52, against 47·52). The chief fact that emerged from the accounts was that taking the great increase in gross receipts, less the small increase in expenses, and bringing into account the increased sum brought in on December 31st, 1910, as against 1909, and the diminished sum required for general interest, they had for distribution in dividends a sum increased by no less than £5,663. This would have enabled them had they chosen to divide up to the hilt, to pay a dividend at the rate not merely of 1¼ per cent., but even at the rate of 2 per cent., and still carry forward more by £113 than they did this time last year. The sum that he mentioned of £5,663, included an increase in gross receipts within the half-year of £5,040. And of this large increase of £5,040 a large proportion was attributable to a genuine increase of their ordinary passenger traffic, of the kind that railway managers and shareholders always regarded as a sound indication of prosperity. He was leading up to a mention of the abnormal and extraordinary traffic and other receipts that were brought to them by the Coronation; but he might point out first, and as evidence of the growth of ordinary traffic, that at the end of the last week before the Coronation they

had recorded an increased passenger traffic of no less than £2,363 The two weeks which comprised the Coronation and all the sights and ceremonies that went before and after it, brought them increases in traffics amounting to £1,400. They made, moreover, about £600 by letting spaces for the erection of stands for spectators of the royal procession. They would, therefore, see that these two non-recurring items of profit just about corresponded in amount with the £1,850 that it would have cost to give them a dividend for the half-year at the rate of 2 per cent. instead of 1¾, plus a small increase of only £113 in the carry over, which in that case would have been all that they could have added to the carry over of June, 1910. The net substance of their recommendations was that in the form partly of a large increase on the large carry over of June, 1910, and partly in the form of the £800 which they put aside for what they had called "general purposes," they proposed to keep in hand for such purposes as the directors might hereafter determine so much of their increased receipts as were to be attributed to special and exceptional causes. The new high-level subway at the Bank station had now been open for nearly three months. It afforded safe and convenient access between their own Bank station and those of the Central London and the Waterloo and City. Last year he intimated that the speed of their trains was a matter which the pressure of competition was forcing upon their attention. They were advised that without incurring such expense as would involve an application to Parliament, it might be possible so to improve their existing locomotives as to reduce by 5 or 6 minutes the time taken in each journey from one end of the system to the other; that was from Clapham Common to Euston. They had sanctioned the expenditure needful for a practical experiment in this direction; and before many weeks were passed he hoped they would have some useful knowledge as to what improvements to their locomotives were practicable, safe, and likely to improve their means of contending with their municipal competitors of the disregarded speed limit and the long purse.

The report was adopted.

Central London Railway Co.

THE directors' report for the half-year ending June 30th gives the financial results as follows:—

	1911.	1910.	
Traffic receipts	£137,846	£146,586	— £8,740
Miscellaneous receipts	12,263	11,753	+ 510
Gross receipts	150,109	158,339	— 8,230
Less working expenses	84,208	87,628	— 3,420
Balance to net revenue account	£65,901	£70,711	— 4,810

After providing for interest on the debenture stock, and other payments, the net revenue account shows that, including the amount brought forward from last half-year, there is an available balance of £76,877, as compared with £85,078 in the corresponding period. After deducting £1,222 for interest on the 4½ per cent. preference stock, there remains a balance of £75,655, out of which the directors recommend the declaration of dividends on the undivided ordinary stock at the rate of 3 per cent. per annum, and on the preferred ordinary stock at the rate of 4 per cent. per annum. These payments will require £39,117, leaving a balance of £36,538. The number of passengers carried since 1906, including those using through tickets and the cheap return tickets issued before 7.30 a.m., is as follows:—

	Half-year ending June.	Half-year ending December.
1907	20,260,871	16,646,620
1908	19,901,750	21,996,623
1909	18,989,109	19,394,285
1910	20,664,896	19,995,960
1911	20,006,287	—

The decrease of 658,609 in the number of passengers carried during the half-year is attributable to the very large increase in motor-omnibus competition along the entire line of route, and to the weather conditions, which have been extremely favourable to omnibus traffic, and also to the fact that the attendance at the Exhibition at Wood Lane—up to this time—has not been as great as in former years. Against this decrease in passenger traffic, it is satisfactory to record that a material saving has been effected in working expenses. The high level subway at the Bank, connecting this railway with the City and South London line, was opened by the Lord Mayor on May 3rd last, and has proved a great convenience to the public. The construction of the Liverpool Street extension is progressing as rapidly as possible, and arrangements have been made with the contractors whereby the work will be expedited six months. The company's Bill, referred to in the last report, under which through running to the Ealing Broadway Station of the Great Western Railway will be secured, has passed through both Houses of Parliament, and now awaits the Royal Assent. The Ozonair system of ventilation is being installed over the whole line, and will be completed during the course of the next few weeks. By this system some 80 million cb. ft. of ozonised air will be pumped daily into the tunnels, which will thus render the atmosphere exceptionally pure. Season tickets were introduced on July 1st, 1911, and are proving popular, and the carriage of parcels has also become a marked feature in the daily work of the company. Sir Henry Oakley, feeling the burden of increasing years, has resigned the chairmanship, but the company will still have the advantage of his advice and assistance as a member of the board. Mr. H. F. Parshall has been elected a director, and appointed chairman of the board. He has been associated with the railway—as consulting engineer—from the beginning, and is acquainted with all the details, both from an engineering and commercial point of view, and, on account of the large number of engineering matters which have to be attended to in the operation of the railway, the directors consider his appointment to be of great importance. Changes have been made in the organisation, which not only render the working arrangements more effective, but at the same time result in great economies in the working of the railway.

The Chili Telephone Co., Ltd.

THE annual general meeting was held at the offices, 42, Old Broad Street, E.C., on Thursday last week, Mr. George Keith presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 28), said that ever since the earthquake disaster in 1906, the company's business year by year had been making steady progress. Last year the Chilian Centenary was celebrated, with great enthusiasm, and it had also been a year of great activity and progress in Chile, in which their business had duly participated. The comparative statement of accounts in their report showed that the revenue in Chile had increased by about 10 per cent. during the year. The improvement was due to the general expansion of all classes of the company's service throughout the country. Whereas by far the greater part of the revenue was collected by annual subscriptions, payable quarterly or half-yearly, the measured rate or toll system had for some considerable time been introduced for inter-town communication, which had resulted during the past year in a very satisfactory increase in the revenue derived from that service. Exchange had also been favourable, the average rate for the previous year being 10·90d. Income in Chile, when converted into sterling, showed an increase for the year of £7,946, and altogether, the result of the year's business was a credit balance of £46,144, which, after providing £22,805 for reserve and £9,900 for interim dividend, paid in January, enabled the board to recommend the payment of a final dividend of £13,200, making, with the interim payment, a total distribution for the year of 7 per cent., free of income-tax, and to increase the balance carried forward to next year's account by £238, to £3,225. The reserve account now stood at £52,300 and investments at cost at £34,784. As regarded the service revenue of the year, the £2,840 expended on replacements of plant had been charged to reserve, and £17,470 on increasing and expanding the property had been carried to the capital expenditure account. Altogether, he thought he could congratulate the shareholders upon the result of the year's operations, and he looked forward to the continued prosperity of the company.

The motion was seconded by the HON. HERBERT T. ALLSOPP and was carried unanimously.

After Mr. Eric B. Butler Henderson, the retiring director, had been re-elected, a vote of thanks to the chairman terminated the meeting.

Montreal Water and Power Co.—For the year ended April 30th, 1911, the gross earnings amounted to $132,150; and the net surplus to $141,155, as against $86,500 12 months ago. $23,549 has been placed to reserve, and $25,283 has been paid in interest on the cost of new works during construction; $40,000 has also been added to reserve for general depreciation, &c. Out of the surplus of $32,822 it is proposed to pay a dividend on the income securities of the company.

Monterey Railway, Light and Power Co.—We gather from the *Financier* that the operations of the company during the past year have been satisfactory. The results of the operations may be summarised as follows:—Gross earnings from railway service, $144,181; expenses, $93,296; net earnings, $50,884; income from Waterworks Co., Light and Power Co. and other sources, $401,873; total net, $452,758; deduct interest on debenture stock, $253,472; dividend on preference stock, $25,000; surplus, $174,286.

Electric and General Investment Co., Ltd.—The directors recommend a dividend at the rate of 6 per cent. per annum on the ordinary shares for the year ended March 31st, being the same as in the previous year.

Notice re Companies.—Notice is given in the *London Gazette* that after three months, unless cause is shown to the contrary, the following companies will be struck off the register and dissolved:—

Formby and Freshfield Electric Light Co., Ltd.
Macclesfield Electric Lighting and Power Co., Ltd.
Penarth Tramway Syndicate, Ltd.
Phœnix Electric Heating Co., Ltd.

STOCKS AND SHARES.

Tuesday Evening.

POLITICAL complications of all kinds, and arising from various quarters of the world, have upset the Stock Exchange markets badly. By the time this issue of the paper is out there may be a

general settling down, but for the time being the prevailing feeling is one of great unrest, and prices in every department of the Stock Exchange have reflected the general nervousness. No doubt people are crying "War, War!" when there is no war, but the very raising of the shout serves to depress prices and investors' courage, with the natural consequence that until calmer waters are reached buyers prefer to keep out of the Stock Exchange altogether.

Home Railway stocks have suffered severely in the depression. Although dividend declarations on the whole are satisfactory, they have been powerless to make any favourable impression against the concatenation of adverse circumstances which have pressed upon them from other directions. Perhaps the firmest market has been that for City and South London Ordinary, which retained its full rise of last week. Central London Ordinary lost 2 points upon the dividend declaration—giving the Ordinary stock 3 per cent., as usual, and providing for the Deferred to receive at the rate of 2 per cent. at the end of the year. The carry-forward, however, is reduced to the extent of £15,000, and this, in the Coronation year, cannot be considered brilliant. Districts have gone back 1¼, while Metropolitans fell ½. There has been a sharp drop in Brighton Deferred stock, and the East London issues fell back a little. Underground Electric income bonds are slightly easier, but Great Northern and City Preferred have regained their loss and are up to £1 middle again.

The home traction companies have been somewhat neglected. British Electric Tractions Preference lost ⅛, and Potteries gave way to a slight extent. Amongst the foreign descriptions the feature is the demand for 5 per cent. bonds, and this has raised the prices in Mexico Trams, Rio Trams and Sao Paulo first Debenture stock. Rio Tramways Ordinary have been a strong market, touching 118½, but the price slipped back to 117. Bombay Preference rose ⅛, United Electric Tramways of Monte Video lost a similar fraction. The demand for first-class Debenture stocks may be further illustrated by the rises in Anglo-Argentine Tramways 4½ per cent. Debenture and Bombay 4½ per cent. Debenture.

Amongst the English Electricity Supply shares, Metropolitan Ordinary are a good feature, with a rise of ⅜ to £4 middle, the block of shares which has been hanging over the market being practically all absorbed. City Ordinary rose ⅛, and Charing Cross Preference are a shade better. On the other hand, London Electric Ordinary and Preference have eased off. The Colonial and Foreign catalogue is chiefly remarkable from the fact that the long-continued fall in Northern Light and Power Bonds has been arrested, and the price shows a rise of a point. The Canadian-Mexican group is steady, and the flatness in other parts of the House has not prevented substantial rises in the prices of Mexican Light and Power varieties. The Common shares have risen no less than 3½, while the Preference are 2½ better, and the 5 per cent. first mortgage bonds gained 1. Canadian General Common stock and Shawinigan Water Capital have both improved. In fact, this market is about the only one where hardly any falls have occurred during the past week.

In the Telegraph market the issue of a report which was regarded as distinctly unsatisfactory has led to sharp falls in the Anglo-American trio. The 6 per cent. Preferred stock lost its rise of last week, and the Deferred fell ⅞. Certainly the showing which is made by the figures cannot be considered at all good, but it is suggested in the market that these figures must not be read as too bad. It is asked with a good deal of curiosity whether part of the Anglo-American profits may not have been possibly included in the takings of the Western Union Company, but this, of course, is sheer guesswork, and the question may have been raised merely by a disappointed bull who wanted to see the prices go better. At the same time the fall, we consider, should frighten nobody who holds the 6 per cent. Preferred stock, and it is conceivable that the unsatisfactory character of the report may help to hasten the desired consummation of complete agreement between the English company and the American.

Direct United States Cable shares, rather singularly, have put on ⅜, and this, perhaps, is not altogether without significance to those who are mystified by the drop in the Anglo-American figures. West India and Panama shares have come into renewed favour, the Ordinary being put up ⅜ upon a steady demand. Marconi shares have fallen back into quietude now that the dividend on the Ordinary shares is actually announced, and on balance the price shows a small fall. This is due to the speculative buyers taking their profits upon their best anticipations being realised, but the holders of the shares who have bought them for investment profess that the price will go much better in the future, provided that no effective competition comes into being—and of that there seems small possibility at present.

National Telephone Deferred rose 2, but lost its gain later on. The stock came into favour upon the consideration that the company will do well in its arbitration, now that the Railway and Canal Commissioners have shown that they do not intend to let the Post Office have everything its own way. That the quotation should have kept steady in days so dull as these is taken as a good augury for the future, and there are still people content to buy the stock in the expectation of being paid off at a much higher rate next year. United River Plate Telephones have fallen 5s., but Chilis are ⅛ better.

In the manufacturing group, Babcock & Wilcox receded ½ upon a small amount of selling, and Telegraph Constructions are 10s. lower. Castner-Kellner shares picked up a little. The Rubber market has been a good deal excited by a rise in the raw material to 4s. 9½d. a pound, with the result that a certain amount of bear covering ensued. To-day's sales at Mincing Lane, however, rather disappointed the optimists, and led to a reaction from the best prices reached for rubber shares last week.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	July 19	3,318	+ 183	7	11,367	+ 798	..	..
Ayr	„ 22	1,560	+ 112	10	3,962	— 58	8	..
Bath	„ 19	2,052	+ 226	29	28,434	+ 886	..	..
Belfast	„ 21	9,681	+ 967	16	74,045	+ 9,348	40	3
Birkenhead	„ 23	2,433	+ 174	16	19,044	+ 902	13·7	..
Birmingham Corp.	„ 15	18,438	+4,940	15	115,179	+12,052	56·8	..
Blackburn	..	..	..	..	..	..	..	..
†Blackpool Corp.	„ 20	2,077	+ 220	..	20,420	+ 3,582	..	..
Blackpool-Fleetw'd	„ 22	2,598	+ 118	3	4,174	+ 405	..	..
Bolton	„ 23	5,149	+ 193	17	42,579	+ 3,348	26	..
Bournemouth	„ 19	3,878	—3,268	16	28,266	— 2,107	22	..
Bradford	„ 15	11,481	+ 675	15	86,398	+ 7,579	56	1·2
Brighton	„ 23	2,894	+ 299	16⅔	17,150	+ 1,655	9·5	..
Bristol	„ 21	14,296	+1,864	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	„ 14	481	+ 16	28	6,091	— 4	3·65	..
Barnsley	„ 14	357	+ 31	„	5,028	+ 307	..	..
Barrow	„ 14	748	+ 89	„	7,638	+ 523	5·37	..
Devonport	„ 14	1,119	+ 298	„	13,035	+ 1,585	8·85	..
Gateshead	„ 14	2,152	+ 146	„	28,612	+ 1,555	11·25	..
Gravesend	„ 14	491	+ 40	„	5,691	+ 147	6·5	..
Greenock	„ 14	1,697	+ 133	„	19,417	+ 2,488	7·25	..
Hartlepool	„ 14	662	+ 91	„	7,021	+ 588	6·72	..
Kidderminster	„ 14	292	+ 13	„	3,001	+ 200	..	..
‡Leamington	„ 14	446	+ 76	„	4,460	+ 70	..	..
Merthyr	„ 14	470	..	„	5,719	+ 84	2·9	..
Metropolitan	„ 14	20,203	+4,535	„	240,160	+37,317	22	..
Middleton	„ 14	770	+ 49	„	9,211	+ 611	8·5	..
Mid. Joint Com'tee	„ 14	8,559	—3,289	„	158,363	+ 5,151	..	..
Oldham—Ashton	„ 14	1,195	+ 34	„	15,663	+ 441	9·13	..
Peterborough	„ 14	492	+ 164	„	3,455	+ 370	5·31	..
Potteries	„ 14	4,061	+ 523	„	53,750	+ 5,353	29	..
Rothesay	„ 14	975	— 60	„	4,046	— 204	2·75	..
Southport	„ 14	811	+ 84	„	8,031	+ 286	8·17	..
S. Metropolitan	„ 14	2,129	+ 368	„	23,320	+ 1,038	..	..
Swansea	„ 14	2,507	+ 192	„	31,015	+ 2,184	12·5	..
Tynemouth	„ 14	721	+ 71	„	6,246	+ 155	3·75	..
Weston-s-Mare	„ 14	710	+ 44	„	3,025	+ 158	3	..
‡Worcester	„ 14	706	+ 66	„	7,869	+ 406	5·75	..
Wrexham	„ 14	222	+ 24	„	2,735	+ 87	..	..
Yorks. Wool. Dist.	„ 14	2,177	+ 168	„	28,897	+ 2,059	17	..
Miscellaneous	„ 14	501	+ 58	„	6,056	+ 331	..	..
Burnley	„ 22	2,672	+ 115	..	..	..	11·7	1
Burton-on-Trent	„ 23	600	+ 49	16	4,781	+ 497	6·6	..
Bury	„ 23	2,603	— 167	16⅔	21,186	+ 1,576	22·5	..
Cardiff	„ 15	2,966	+ 483	15	38,682	+ 4,020	..	..
Chatham and Dist.	„ 20	1,982	+ 232	29	23,844	+ 293	14·98	..
Cork	„ 20	1,195	+ 61	29	14,187	+ 2,2	9·9	..
†Croydon	..	..	..	..	..	..	..	..
Darlington	„ 22	472	+ 56	17	3,729	+ 403	..	..
Darwen	„ 21	534	+ 26	16	4,422	+ 397	4·36	..
Dover	„ 15	591	+ 112	15	3,874	+ 686	4·75	..
Dublin	„ 21	18,533	+6,256	..	26,170	+ 8,132	54·25	..
Dundee	„ 19	2,447	+ 2	99	11,323	— 83	15	..
East Ham	„ 22	2,252	+ 152	16½	18,077	+ 1,265	7·87	1
†Exeter	„ 15	404	+ 30	..	5,296	+ 409	5·5	..
Glasgow	„ 22	35,072	+3,142	..	144,183	+ 9,997	98	·75
Hastings	„ 20	2,462	+ 169	..	..	..	..	..
Huddersfield	..	..	..	..	..	..	..	..
Hull	„ 22	5,719	+ 349	16	46,269	+ 2,434	14·5	..
Ilkeston	„ 19	269	+ 8	16	2,148	+ 104	..	..
Ipswich	„ 22	1,040	+ 86	16	7,375	+ 784	10·5	..
†Kilmarnock	„ 15	202	+ 39	9	1,452	+ 98	4·4	..
Lancashire United	„ 19	2,229	+ 182	29	28,266	+ 1,014	39	..
Leeds	„ 22	16,022	+1,516	16	124,038	+10,182	108	..
Leicester	..	..	..	..	..	..	..	..
Leith	„ 22	1,756	+ 356	99	7,007	+ 581	3·72	..
Liverpool	„ 16	25,154	+1,827	29	320,614	+12,227	116	2·5
†L.C.C.	„ 12	98,806	+7,410	15	671,067	+48,114	141	9
London United	„ 22	15,817	+1,912	..	188,220	+ 8,347	..	..
Lowestoft	..	..	..	..	..	..	2·5	..
Manchester	„ 22	33,147	+1,616	17	266,035	+15,495	133	..
Newcastle	„ 22	8,476	+ 380	..	70,250	+ 4,841	14·5	..
Newport	„ 15	1,519	+ 120	15	11,285	+ 854	14·5	..
Oldham	„ 23	4,138	+ 331	17	34,340	+ 2,023	22·5	·6
Portsmouth	..	..	..	..	..	..	15·25	..
†Preston	„ 13	318	+ 55	..	..	..	..	..
Salford	„ 17	10,360	+ 584	16⅔	76,998	+ 4,440	..	..
Sheffield	„ 23	12,927	+1,031	17	101,583	+ 7,621	40	..
Southampton	„ 19	2,760	+ 456	16	19,727	+ 2,477	..	..
Southend-on-Sea	„ 19	1,654	+ 217	16	10,569	+ 1,606	..	..
South Shields	„ 22	1,854	+ 155	16	10,421	+ 1,408	..	..
Swindon	„ 19	318	+ 57	16	2,519	+ 345	..	..
Tyneside	„ 19	1,088	+ 56	8	1,433	+ 21	..	..
Wallasey	„ 22	2,431	+ 251	16	18,589	+ 3,079	..	..
Walthamstow	„ 22	1,690	+ 178	16	13,111	+ 1,341	9	..
West Ham	„ 13	5,788	+ 699	15	41,897	+ 4,611	15·25	..
Wolverhampton	„ 19	2,204	+ 141	16	16,163	+ 1,241	25	..
Cen. London Rly.	„ 22	9,526	—1,789	3	14,624	— 2,717	6·25	..
City & S. Lon. Rly.	„ 23	6,199	+ 54	3	9,376	+ 98	7·25	..
Dublin-Lucan Rly.	„ 21	258	— 2	3	509	— 14	7	..
G.N. and City Rly.	„ 22	2,784	+ 88	3	4,222	+ 128	3·5	..
L'pool Overh'd Rly.	„ 23	3,217	+ 338	3	4,844	+ 508	6·8	4·3
Llandudno-Col. Bay	„ 21	1,110	+ 139	33⅓	7,347	+ 390	..	..
London Elec. Ry. Co.	„ 22	25,530	+1,140	3	38,520	+ 1,370	21·25	..
Mersey Railway	„ 22	3,904	— 57	3	5,775	— 69	4·5	..
Metropolitan Rly.	„ 23	34,506	+ 399	3	52,342	+ 707	24·5	..
Met. District Rly.	„ 22	22,842	+1,575	3	31,910	+ 2,479	24	..
Anglo-Argentine	„ 22	94,761	+8,092	..	1,423,135	+142,257	..	..
§Auckland	June 30	17,327	+2,469	52	210,167	+22,754	23·2	·6
Bombay (B.E.T.)	July 23	5,621	+ 894	25	71,437	+ 3,994	..	..
Brisbane	May	21,099	+2,609	..	..	..	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	July 22	7,755	+ 751	..	..	..	..	..
Cape Electric T. Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	June	3,649	..	..	20,434	..	20·5	..
§Lisbon	..	..	..	..	..	..	..	..
Madras	July 15	1,537	+ 245	..	18,956	+ 1,526	..	..
§Montevideo	June	21,752	+1,376	34	204,345	+11,496	..	..
Perth (W.A.)	July 21	3,185	..	..	46,959	+ 2,684	29	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations July 25th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5½	8 — 9	..	6 2 3
Do. 4½ % Pref.	10	4½	4½	9 — 10	..	4 10 0
Do. Second 6 % Pref.	10	6	6	10¼ — 10⅝	..	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	101 —103	+½	4 7 5
Brompton & Kensington, Ord.	5	10	10	8 — 8¼	..	5 17 8
Do. 7 % Cum. Pref.	5	7	7	7⅛ — 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City Do. 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅛ 4⅝ — 5⅛	..	5 14 3 4 7 10
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅛	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	94 — 98	..	4 1 8
Chelsea, Ord.	5	4½	5	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	98 —100	..	4 10 0
City of London, Ord.	10	7	7	12 — 12½	+ ⅛	5 12 0
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 10 0
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½ — 91½	..	5 9 3
County of London, Ord.	10	5	5	7⅝ — 8⅛	..	6 3 1
Do. 6 % Pref.	10	6	6	11¼ — 11⅝	..	5 2 2
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	5	Nil	Nil	1/16 — 1/8	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2 — 2¼	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87 xd	..	5 3 6
Folkestone	5	5½	6	4¼ — 4⅝	..	6 9 9
Do. 5 % Cum. Pref.	5	5	5	4¾ — 5¼	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	97 —100	..	4 10 0
Hove	5	8½	9	6¾ — 7¼	..	6 4 2
Kensington & Knightsbridge, Ord	5	8	9	7 — 7¾	..	6 2 0
Do. 4 % Deb.	Stock	4	4	91 — 93 xd	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	78 — 82 xd	..	5 9 9
London Electric, Ord.	3	2	2	1⅝ — 2	— ⅛	3 0 0
Do. 6 % Pref.	5	6	6	4⅝ — 5	— ⅛	6 0 0
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 9
Metropolitan	5	5	5	3⅝ — 4¼	+ ⅛	5 17 8
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4⅝	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	100 —105	..	4 5 9
Do. 3½ % Mort. Deb.	Stock	3½	3½	84½ — 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Newcastle-on-Tyne	5	4	4	3¾ — 4	..	5 0 0
Do. 5 % Pref., Non. Cum.	5	5	5	4 — 4½	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 — 104	..	4 16 2
Notting Hill	10	7½	8	..	..	6 5 6
Oxford	5	7	7½	6½ — 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10	9 — 9½	..	5 5 3
Do. 7 % Pref.	5	7	7	6⅜ — 7⅛	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	84½ — 86½	..	4 0 11
Smithfield Markets, Ord.	5	Nil	Nil	1⅜ — 1⅝	..	Nil
South London, Ord.	4	5	5	2 1/16 — 2 3/16	..	6 5 0
Do. 5 % First Mort. Deb.	100	5	5	99½—101½	..	4 18 6
South Metropolitan, 7 % Pref.	1	7	7	1⅜ — 1⅝	..	5 12 0
Do. 4½ % First Deb. Stock	100	4½	4½	97 —100	..	4 10 0
Urban, Ord.	5	5	5	½ — 1	..	..
Do. 5 % Cum. Pref.	5	5	5	2½ — 3	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	87 — 89	..	5 1 2
Westminster, Ord.	5	10	10	7¼ — 8¼	..	6 1 2
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅜	..	4 3 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Calcutta, Ord.	5	8	8½	6⅜ — 7⅛	..	5 19 4
Do. 5 % Pref.	5	5	5	4⅝ — 5⅜	..	4 13 0
Calgary Power, 1st Mort. Bds.	100	5	5	96 — 98	..	5 2 0
Canadian Gen. El. Com.	$100	7	7	111 —116	+2	6 0 8
Do. 7 % Pref.	$100	7	7	120 —123	..	5 13 10
Cordoba Lt., Power and T., Ord.	1	2	3	¾ — ⅞	..	3 8 4
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	..	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	86½ — 88½	..	5 13 0
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	Nil	1/16 — 1/8	..	..
Do. 6 % Pref.	1	6	6	13/32 — 15/32	..	8 6 8
Kaministiquia Power, 5 % G. Bs.	$500	5	5	101 —103	..	4 17 1
Madras, Ord.	5	Nil	..	2⅝ — 3⅛	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	95 — 97	..	5 3 1
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	89 — 90	+1½	5 11 1
Mexican Lt. & Power, Common	$100	4	4	86 — 88	+4½	4 10 11
Do. 7 % Cum. Pref.	$100	7	7	109 —111	+2½	6 6 2
Do. 5 % 1st Mort. Gold Bds.	..	5	5	97½ — 98½	+1	5 1 6
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	89½ — 91½	+ ½	5 9 3
Montreal, Lt., H. and Power	$100	6	7	173 —177	..	3 19 1
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	44 — 46	+1	10 17 4
River Plate, Ord.	Stock	9	10	218 —228	..	4 7 9
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	101½—103½	..	4 16 7
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	4	4	119½—121½	+ ½	3 5 10
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	103 —105	..	4 5 9
Toronto Power, 4½ % Deb.	Do.	4½	4½	99 —101	..	4 9 1
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	+ ½	5 6 5
Victoria Falls Power, Pref.	1	Nil	Nil	1⅛ — 1	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	..	6	108½—110½	..	5 8 7

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	Nil	7⅜ — 7⅝	..	Nil.
Do. 5 % Deb. Red.	Stock	5	5	98 —100	..	5 0 0
American Telep. & Teleg., Cap.	$100	8	8	142 —144	..	5 11 1
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph	Stock	3⅜	3⅜	68 — 70	—1	5 7 2
Do. 6 % Pref.	Do.	6	6	112½—113½	—1½	5 5 9
Do. Def.	Do.	25/-	30/-	25⅜ — 25⅝	— ⅜	5 16 0
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	8	6†	7 — 7¼	+ ⅛	5 12 3
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	87½ — 89½	..	4 9 5
Cuba Telegraph	10	6	6	10 — 10⅜	..	5 11 7
Do. 10 % Pref.	10	10	10	17½ — 18¼	..	5 9 7
Direct Spanish Telegraph, Ord.	5	4	4	3⅝ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	8⅜ — 8⅝	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	99 —101	..	4 9 1
Direct United States Cable	10	4½	4½	7⅞ — 8⅜	— ⅜	5 7 5
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98 —100	..	4 10 0
Eastern Telegraph, Ord. Stock	Stock	7	7	136 —139	..	5 0 9
Do. 3½ % Pref. Stock	Do.	3½	3½	84 — 86	..	4 1 5
Do. 4 % Mort. Deb.	Do.	4	4	101 —103	..	3 17 8
Eastern Extension	10	7	7	13½ — 13⅝	..	5 1 10
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99½—101½	..	3 18 10
Globe Telegraph and Trust	10	5⅞	5⅞	10⅜ — 11½	..	5 4 5
Do. 6 % Pref.	10	6	6	13 — 13⅝	..	4 8 11
Great Northern Telegraph	10	18	18	31 — 32	..	5 12 6
Indo-European Telegraph	25	13	13	56½ — 58½	..	5 11 1
Mackay Companies Common	$100	4	5	92 — 94	..	5 6 5
Do. 4 % Cum. Pref.	$100	4	4	75 — 77	..	5 3 11
Marconi's Wireless Telegraph	1	Nil	Nil	2 1/16 — 2 3/16	— ⅛	Nil.
Monte Video Telephone, Ord.	1	6	6	⅞ — 1	..	6 0 0
Do. 5 % Pref.	1	5	5	⅝ — ¾	..	5 10 4
National Telephone, Pref.	Stock	6	6	105⅜—106⅜	..	5 13 8
Do. Def.	Do.	6	6	119 —122	..	4 18 4
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5⅜ — 5⅝	..	4 8 11
Do. 3½ % Deb.	Stock	3½	3½	98 —100	..	3 10 0
Do. 4 % Deb.	Do	4	4	98 —100	..	4 0 0
New York Telep., 4½% Gen. Bnds.	100	4½	4½	102½—103½	..	4 7 0
Oriental Telep. and Elec.	1	8	8	1 1/16 — 1 1/8	..	4 8 3
Do. 6 % Cum. Pref.	1	6	6	1⅛ — 1⅜	..	4 16 0
Do. 4 % Red. Deb.	Stock	4	4	87½ — 89½	+ ½	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99 —101	..	3 19 3
Reuter's	8	5	5	8⅝ — 9⅛	..	4 7 9
Submarine Cables Trust	Cert.	6	6	131 —134	..	4 8 11
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	98½—100½	+ ½	4 9 7
United River Plate Telephone	5	8	8	7⅞ — 7 11/16	+ ⅛	5 4 1
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1⅛ — 1⅜	..	6 5 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	97½ — 99½	..	4 0 5
West India and Panama Teleg.	10	Nil	¾	2⅝ — 2⅞	+ ⅛	2 12 2
Do. 6 % Cum. 1st Pref.	10	6	6	10⅝ — 10¾	+ ⅛	5 11 7
Do. 6 % Cum. 2nd Pref.	10	14½	6	9⅝ — 10	..	6 0 0
Do. 5 % Debs.	100	5	5	101 —103	..	4 17 1
Western Telegraph, Ltd.	10	7	7	13⅝ — 14⅛	..	4 18 3
Do. 4 % Deb.	Stock	4	4	99 —101	..	3 19 3
Western Union Tel., 4% Bnds. A	$1000	4	4	105 —108	..	3 14 1
Do. 4½ % Fdg. Bonds	$1000	4½	4½	99½—102½	..	4 7 10

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations July 25th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	Nil	⅛ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	⅜ — ½	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5
Brit. Elec. Trac., Ord.	10	Nil	Nil	⅞ — 1⅛	..	Nil
Do. 6 % Pref.	10	1½	1½	9⅝ — 9¾	— ⅛	3 12 9
Do. 5 % Deb.	100	5	5	94 — 97	—1	5 3 1
Do. 4½ % 2nd Deb.	100	4½	4½	77 — 81	..	5 11 1
Central London Railway, Ord.	100	3	3	69 — 71	—2	4 4 6
Do. Pref.	100	4	4	87 — 89	..	4 9 11
Do. Def.	100	2	2	55 — 57	..	3 10 2
Do. 4 % Deb.	100	4	4	102 —104 xd	..	3 16 11
City & South London, Ord.	100	1¾	1½	33 — 34	..	4 8 3
Do. 5 % Pref., 1891	100	5	5	110 —112	+1	4 9 3
Do. Do. 1896	100	5	5	105 —108	..	4 12 7
Do. Do. 1901	100	5	5	104 —107	..	4 13 6
Do. Do. 1903	100	5	5	103 —106	..	4 14 4
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 7
Dublin United Trams, 6 % Pref.	10	6	6	12½ — 13½	..	4 10 7
Great Northern & City, Pr'f. Ord	10	Nil	Nil	⅝ — 1⅛	+ ⅛	Nil
Hastings Trams, 6 % Pref.	5	Nil	Nil	.. ..	..	Nil
Do. 4½ % Deb.	100	4½	4½	75 — 80	..	5 12 6
Isle of Thanet Trams, 5 % Pref.	5	1¼	2½	2⅛ — 2⅝	..	4 10 11
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 82	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	Nil	3⅜ — 4⅛	..	Nil
Do. 4 % Deb.	100	4	4	74 — 77	..	5 3 11

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations July 25th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	* 100	1	1⅛	47¾ — 48¼	— ¾	2 17 0
Do. Surplus Lands	100	2⅜	2⅜	68 — 70	—1	3 18 7
Do. 3½ % Deb.	100	3½	3½	92 — 4 xd	..	3 14 6
Do. 3½ % Pref.	100	3½	3½	90 — 92	..	3 16 1
Do. 3½ % Con. Pref.	100	3½	3½	89 — 91	..	3 16 11
Metropolitan District Ord.	100	Nil	Nil	27¼ — 27½	—1¼	Nil
Do. 6 % Deb.	100	6	6	145 —147	..	4 1 8
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	—1	3 18 5
Do. 4½ % First Pref.	100	Nil	3¼	89 — 91	..	3 11 5
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5½	33/32 — 1 1/32	..	5 6 8
Do. Def.	1	Nil	Nil	1/32 — 3/32	..	Nil
Do. 5 % Pref.	1	5	5	33/32 — 1 1/32	..	4 17 10
Do. 4½ % Deb.	100	4½	4½	99 —101	— ½	4 9 1
Do. 5 % Deb.	100	5	5	102½ —104½	..	4 15 8
Potteries, Ord.	1	2	2	3/32 — 5/32	— 1/32	..
Do. 5 % Pref.	1	5	5	3/32 — 5/32	..	7 13 6
Do. 4½ % Deb.	100	4½	4½	88 — 91	..	5 18 11
South Metro. Trams, 6 % Pref.	1	3	6	1/32 — 1/16	..	10 3 0
Do. 4 % Deb.	100	4	4	73 — 78	..	5 15 5
Underground Elec. Railways 5 % Prior Lien	..	5	5	100½ —101½	..	4 18 6
Do. 4½ % Bonds	100	4½	4½	99 —101	..	4 9 1
Do. 6 % Income	100	Nil	1	64 — 66	—1	1 10 4
Do. Power House Debs.	100	..	4	101 —103	..	3 17 8
Yorkshire (West Riding), Ord.	5	Nil	Nil	1/32 — 3/32	..	Nil
Do. 6 % Pref.	5	Nil	Nil	2/32 — 2/32	..	Nil
Do. 4½ % Deb.	100	4½	4½	82 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5	5 1/16 — 5 3/16	..	4 16 5
Do. 2nd Pref.	5	5	5	4 13/16 — 5 1/16	..	4 18 9
Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Do. 4½ % Deb.	100	4½	4½	99½ —101½	+ ½	4 8 8
Do. 5 % Deb.	100	5	5	100 —102	..	4 18 0
Auckland Trams, 5 % Deb.	100	5	5	102 —104	..	4 16 2
Bombay Elec. S. & Trams, Pref.	10	6	6	11 — 11½	+ ⅛	5 4 4
Do. 4½ % Deb.	100	4½	4½	96½ — 98½	+ ½	4 11 5
Do. 5 % 2nd Deb.	100	5	5	96½ — 98½	..	5 1 6
Brisbane Trams Invt., Ord.	5	8	8	6⅝ — 6¾	..	5 16 5
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	8	141 —145	+1	5 10 4
Do. Pref. Ord.	100	6	6	120 —124	..	4 16 9
Do. 5 % Pref.	100	5	5	106 —119 xd	—1	4 11 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	101 —104 xd	..	4 6 7
Do. 4½ % Con. Deb.	100	4½	4½	101½ —103½	..	4 7 0
Calcutta Trams, Ord.	5	4½	6	5¼ — 6¼	..	4 16 0
Do. 5 % Pref.	5	5	5	5 — 5¼	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	Nil	1/32 — 1/16	..	Nil
City Buenos Aires Trams (1904)	5	5	5	5⅛ — 5⅜	..	4 5 1
Do. 4 % Deb.	100	5	5	94 — 97	..	5 3 1
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 —100	..	5 0 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —102 xd	..	4 18 0
Kalgoorlie Elec. Trams	1	Nil	Nil	1/32 — 3/32	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	6	5	63 — 67	..	7 9 3

La Plata Elec. Trms, Prf, 17/6 pd.	1	6	6	13/16 — 15/16	..	6 8 0
Lisbon Elec. Trams, Ord.	1	5½	5½	1 — 1⅛	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	97 —101	..	4 19 0
Madras Elec. Tr. (1904), Deb.	100	5	5	95 — 98	..	5 2 0
Manaos Trams & Lt., 1st Deb.	100	..	5	90½ — 93½	..	5 6 11
Manila Elec. R. and Ltg., Bonds	$1000	5	5	99½ —101½	..	4 18 6
Mexico Trams Com.	$100	7	7	120 —122 xd	—1	5 14 9
Do. Gen. Con. 5 % Bonds	..	5	5	98 — 99	+1⅛	5 1 0
Do. 6 % Bonds	100	6	6	99 —101	..	5 18 10
Para Elec. Rlys. & Lt., Ord.	5	..	10	7 — 7⅛	..	6 15 7
Do. 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	99⅞ —101⅞	..	4 18 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	3/32 — 5/32	..	..
Do. 5 % 1st. Deb.	100	5	5	101½ —103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅛ — 5⅝	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	97 —100	..	4 10 0
Rio de Janeiro Trams	$100	1	4½	116½ —117½ xd	+1	3 16 7
Do. 1st Mort. 5 % Bonds	..	5	5	101 —102	..	4 18 0
Do. 5 % Mort. Bonds	100	5	5	97¼ — 98¼	+ ¼	5 1 9
Sao Paulo Tram, Lt. and P.	$100	10	10	183 —186	..	5 7 6
Do. 5 % 1st Deb.	$500	5	5	103 —105	+ ½	4 15 3
Singapore Trams, 5 % Deb.	100	5	5	83 — 87	..	5 15 0
Southern El. Tr. B.A., 5 % Deb.	100	5	5	97 —100	..	5 0 0
Un. Elec. Trams Monte Video	5	5	6	5⅝ — 6⅛	— ¼	4 18 0
Do. 6 % Pref.	5	6	6	5 — 5⅛	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	102 —105	..	4 15 3
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	107 —109	..	4 2 7

MANUFACTURING COMPANIES.

Aron, Ord.	1	..	6	2/32 — 3/32	..	8 0 0
Do. 6 % Pref.	1	10	12	1⅛ — 1⅜	..	7 7 8
Babcock & Wilcox	1	24	26	5 1/16 — 5 1/16	— ⅛	4 15 7
Do. Pref.	1	6	6	1⅛ — 1⅜	..	4 0 0
B.I. & Helsby Cables	5	10	10	6¾ — 7⅛	..	6 15 7
Do. Pref.	5	6	6	5 — 6⅛	..	4 12 4
Do. Deb.	100	4½	4½	102 —104	+1	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	96 — 99	..	4 10 11
British Westinghouse, Pref.	3	Nil	Nil	3/32 — 5/32	..	Nil
Do. Deb.	100	4	4	59 — 62	..	6 9 1
Do. 6 % Prior Lien	100	6	6	102 —104	..	5 15 5
Browett, Lindley, Ord.	1	Nil	Nil	1/6—2/-	..	Nil
Do. Pref.	1	Nil	Nil	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	Nil	1/32 — 2/32	..	Nil
Do. 7 % Pref.	2	Nil	Nil	1/32 — 2/32	..	Nil
Do. 4½ % Deb.	100	4½	4½	59 — 64	..	7 0 8
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	15	8⅜ — 9⅛	..	8 2 2
Do. Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	14	17½	31/32 — 1 1/32	+ 1/32	4 17 4
Do. Deb.	100	4½	4½	104 —107	..	4 4 1
Crompton & Co.	3	Nil	Nil	1/32 — 3/32	..	Nil
Do. Deb.	100	5	5	57½ — 67½	..	7 8 2

Dick, Kerr	1	6	5	13/16 — 15/16	..	5 6 8
Do. Pref.	1	6	6	1 1/32 — 1 1/32	..	5 9 7
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	Nil	2/32 — 1/16	..	Nil
Do. fully paid	5	Nil	Nil	1/16 — 2/32	..	Nil
Do. 4 % Deb.	100	4	4	67 — 71	..	5 12 8
Do. 5 % Second Deb.	100	5	5	78 — 81	..	6 3 5
Electric Construction	2	Nil	Nil	3/32 — 5/32	..	Nil
Do. Pref.	2	7	7	1 1/16 — 2 1/16	..	6 15 9
Greenwood & Batley, Pref.	10	7	7	7⅛ — 8¼	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8⅛ — 9	..	5 11 1
Do. Deb.	100	4	4	88 — 93	..	4 6 0
Henley's, Ord.	5	15	15	12⅛ — 12⅞	..	5 16 6
Do. Pref.	5	4½	4½	4⅞ — 5⅛	..	4 7 10
Do. Deb.	100	4½	4½	106 —108	..	4 3 4
India-Rubber, G. & T.	10	10	10	11⅛ — 13⅛	..	7 8
Do. Pref.	10	5	5	10⅛ — 10⅞	..	4 15 3
Telegraph Construction	12	17½	20	35 — 37 xd	— ½	6 7 2
Do. Deb.	100	4	4	99 —101	..	3 19 3
Willans & Robinson	1	Nil	Nil	1/32 — 3/32	..	Nil
Do. Pref.	5	1½	Nil	¼ — 1	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3 1

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JUNE, 1911.

THE June returns of electrical business, although satisfactory, show some falling off when compared with the excellent figures recorded in the previous month.

The June exports totalled some £366,614 in value, the May figures being £379,050. The former figure includes a larger amount of telegraphic material than in May, and the value of the general business (less telegraphic) consequently reached only £309,559, which is somewhat below the average of the previous months of this year.

The imports amounted to £183,260 in value, as compared with £200,749 in May, while the re-exports rose to £28,688 in value which is the highest amount we have so far recorded in this section.

The June machinery exports reveal a considerable decrease as compared with the previous month, but cable exports remain at a high level, and increases are shown in telegraph, telephone and lamp exports.

Machinery and cable imports were slightly better in June, but lamp and telegraphic and telephonic imports show a falling off.

Our most prominent customer during the month was Japan, with India, and the South American and Australian States following.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	1,200	1,898	57	81	100	3,174	290	92	...	113	11,182	18,187
Germany	940	1,586	13	460	421	2,334	80	75	...	13	6	5,928
Netherlands, Java and Dutch Indies	537	1,368	269	27	74	898	...	17	...	19	11,332	14,541
Belgium	1,004	465	38	361	53	6,122	94	...	...	3,282	908	12,327
France	1,468	225	792	957	...	4,553	78	21	...	69	189	8,352
Portugal	...	59	37	181	26	53	...	...	...	...	212	568
Spain, Canary Isles, Spanish N. Af. & Morocco	418	...	227	94	682	2,976	270	24	...	...	72	4,763
Switzerland, Italy and Austria-Hungary ...	2,038	98	90	279	32	4,181	15	25	...	98	2,278	9,134
Greece, Bulgaria and Turkey	48	...	53	66	29	675	60	481	23	6	223	1,664
Channel Isles, Gibraltar, Malta and Cyprus ...	138	196	59	10	38	438	...	9	15	30	227	1,160
U.S.A., Philippines and Cuba	18	...	106	280	302	222	...	...	135	27	...	1,090
Canada and Newfoundland	678	3,066	295	1,204	[1,005	6,554	645	173	...	183	310	14,113
British West Indies, British Guiana and Falkland Islands	86	56	14	223	45	1,559	9	35	...	118	52	2,197
Mexico and Central America	126	4,507	27	...	...	64	...	...	...	448	311	5,483
Peru and Uruguay	13	372	114	79	...	444	385	246	79	34	45	1,811
Chile	119	73	500	...	...	1,276	7	22	44	374	6	2,421
Brazil	1,093	3,615	558	210	61	8,148	488	101	54	654	5,965	20,947
Argentina	2,739	3,054	559	895	235	16,433	52	3,320	159	1,525	5,318	34,289
Colombia, Venezuela and Ecuador	78	...	4	...	...	1,027	...	3	...	...	60	1,172
Egypt, Tunis and Persia	298	113	48	43	3	373	289	658	...	77	361	2,263
British West Africa and Liberia	151	306	8	179	28	370	...	42	55	138	206	1,483
Rhodesia, O.R.C. and Transvaal	1,612	2,086	395	1,533	25	4,842	423	221	67	183	652	12,039
Cape of Good Hope	1,118	2,644	183	476	130	1,201	...	246	...	156	62	6,216
Natal	1,176	6,566	142	645	94	1,301	...	881	...	28	176	11,009
Zanzibar, Brit. East Africa, Mauritius & Aden	32	78	37	75	...	102	...	6	18	30	11,743	12,121
Madeira, Portuguese Africa and India ...	115	297	58	930	192	351	26	162	...	...	260	2,391
French African Colonies and Madagascar ...	49	...	...	44	25	124	...	...	...	...	...	242
China and Siam	622	1,620	342	782	60	1,975	1,317	153	15	443	...	7,329
Japan and Korea	1,486	4,735	317	70	1,659	13,582	4,835	...	143	14,902	896	42,625
India	2,927	6,735	1,043	1,548	185	3,583	3,220	1,347	129	450	2,360	23,527
Ceylon	196	429	146	60	377	82	578	19	42	219	...	2,148
Straits Settlements and Fed. Malay States ...	393	439	261	24	87	1,025	878	...	...	83	572	3,762
Hong Kong	195	470	172	486	261	699	57	60	...	18	129	2,547
West Australia	166	1,117	20	264	47	1,677	...	24	...	...	75	3,390
South Australia	344	134	188	89	365	5,216	10	11	...	982	19	7,358
Victoria	951	8,173	122	919	242	4,357	79	383	...	4,471	...	19,697
New South Wales	3,454	4,544	591	1,962	837	4,324	8	163	24	4,571	57	20,535
Queensland	206	713	7	392	70	4,755	221	9	...	1,412	162	7,947
Tasmania	66	76	...	26	...	...	...	200	...	1,848	...	2,216
New Zealand and Fiji Islands	1,187	3,113	474	566	356	7,549	275	193	62	1,218	629	15,622
Total, £	29,485	65,026	8,366	16,520	8,146	118,619	14,689	9,422	1,064	38,222	57,055	366,614

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	12	...	...	82	...	3,694	80	597	...	6,621	11,086
Germany	1,634	5,091	2,290	18,793	2,409	54,592	565	905	3,110	23,916	113,305
Holland	...	...	...	1,209	...	5	47	...	73	48	1,382
Belgium	340	1,172	11	175	78	1,494	...	169	227	5,778	9,444
France	1,162	1,050	1,272	2,266	833	1,349	...	666	3,094	1,705	13,427
Switzerland	183	922	77	46	48	796	...	...	7	...	2,079
Italy	...	319	...	11	...	...	3	...	...	3,703	4,036
Austria-Hungary	...	910	...	706	230	153	588	36	149	550	3,322
United States	3,682	452	188	1,663	1,050	11,279	4,847	187	1,011	95	24,454
Total, £	7,013	9,946	3,838	24,951	4,648	73,362	6,130	2,560	7,671	42,416	182,535

Additional imports: Spain, carbons, £235; Canada, goods, £427; Newfoundland, telegraph material, £63.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above	15,733	629	...	1,829	...	9,052	...	268	882	295

TOTAL EXPORTS: £366,614. TOTAL RE-EXPORTS: £28,688. TOTAL IMPORTS: £183,260.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

THE CONFERENCE ON THE EDUCATION AND TRAINING OF ENGINEERS.

(*Concluded from page* 86.)

IN Section II, on the second day, notes on "The Position and Uses of Engineering Laboratories" were read by Prof. W. D. Dalby, Prof. J. Goodman and Prof. Bertram Hopkinson.

PROF. DALBY said that the outstanding feature of our modern system of scientific education was the laboratory; it was now recognised as an essential instrument in all branches of scientific education. In a lecture-room a student heard things, but in a laboratory he did things; a normal student remembered what he did and forgot the greater part of what he heard.

From the point of view of teaching, the individual items of the apparatus provided should be numerous, typical and small, so that there might be plenty of experiments for small groups of students to carry out for themselves.

In an engineering laboratory the students must do the job, and not look on while the job was being done by the professor on a large and expensive piece of apparatus too costly to be entrusted to them.

From the point of view of research, the chief provision to be made was space, time, and a workshop in which apparatus could be made, to supplement the apparatus often of an expensive kind provided for research.

The fundamental principles upon which engineering practice was based were few in number, but their applications were almost infinite. A principle could only be thoroughly grasped through a study of its applications. Hence to engineering students a principle should be taught by means of applications selected from those which had a bearing upon engineering.

All students of engineering should gain some familiarity with the physical properties of steam and gases and with the materials of construction. The fundamental principles of thermodynamics should be taught through their applications to estimate the efficiency of heat motors of all kinds. A student learnt a good deal by testing heat engines.

Above all, in passing through the course, the student should catch something of the spirit of research which should brood over every engineering laboratory, from the smallest to the greatest.

PROF. JOHN GOODMAN said it was well at the outset to recognise that the equipment and scope of an engineering laboratory differed essentially from that of a college workshop. The work carried on in the latter was mainly for the purpose of teaching the art or trade of engineering, but the work done in the former had the sole object of teaching the principles which underlay that art or trade. If properly-schemed laboratory work could be arranged to run concurrently with the lectures the student was brought more closely into touch with the concrete side of his subject, and thereby not infrequently discovered his own shortcomings. He should, in the early stages, be left severely alone to worry out his problems, but if actually beaten, then, and not until then, should the director of the laboratory come to his assistance.

The engineering laboratory afforded the student an excellent training in the carrying out of experiments for the purpose of obtaining accurate data, and he could not fail to be early impressed with the paramount importance of keeping all the conditions of the test constant except the two variables under consideration. He, moreover, discovered that absolute accuracy in data was rarely, if ever, attainable, and therefore the use of many significant figures was not only absurd but tended to deception.

It was a mistake in the first instance to insist on students worrying about minute accuracy.

In purchasing apparatus for the equipment of an engineering laboratory, the aim should be to make all apparatus as simple as possible, and each piece should be designed to bring out clearly one particular point, all unnecessary complication being dispensed with. Distinction must always be drawn between apparatus which might be used by the staff for their own education and for research work and that required exclusively for students.

It would be better in every respect to purchase two or three commercial engines of different types for testing purposes rather than to crowd complication on to one experimental engine.

In some cases enterprising firms lent engines and plant to colleges for testing purposes on condition that the results of all tests should be supplied to the makers in return for the loan, and when the firm in question brought out an improvement the obsolete plant was exchanged for the new. The arrangement from the college point of view was, of course, ideal, and the firms in question were not entirely losers by the bargain.

It was an utterly bad system to have the apparatus required for each experiment set out permanently in working order, and to give printed detailed instructions and log sheets to each student, which he mechanically followed. The following of such a system entirely crushed all originality, and made the student into a mere machine. After he had once got over the initial stages he ought to rig up his own apparatus, check it for accuracy, make out his own log sheets, and reduce his results.

It was of vital importance that the director should be a man familiar with practical work, or he might unwittingly encourage students to play with unreal problems, which tended to divert their attention from the actual difficulties that arose in the life of an engineer.

PROF. BERTRAM HOPKINSON said that engineering science must be based on the intelligent observation of things as they occurred in practice. Experiments in an engineering laboratory might be of great assistance, but in interpreting their results, it must never be forgotten that the artificial control of conditions, which was of the essence of experiment, was of itself a disturbing factor. The position of the engineering laboratory as an instrument of education was not quite the same thing as its position in relation to research, but was closely related to it. The student was introduced to phenomena under conditions which in their complexity resembled those of real life, and which could only partially be controlled. Thus he learnt in a simple way to use his judgment in interpreting data, and to recognise how in a complex mechanism it was impossible to vary a single element without at the same time affecting a number of others. This training of the faculties of criticism and observation was valuable to anyone, whatever profession he was going to follow.

Work in the engineering laboratory proper should be preceded by a short course of ordinary physical experiment under the simplest possible conditions. Having thus acquired a knowledge of the fundamental scientific principles, the student's work in the engineering laboratory would be directed largely to tracing their operation under more complex circumstances. For this purpose small units of plant of a simple character were quite adequate. In fact, the smaller and simpler machines were better for this purpose, because they were more easily handled, and he could be left more to himself. But, though small, the machines in the engineering laboratory should be real commercial machines, such as were bought and sold in the ordinary course of business, and the students should use them under ordinary working conditions. Extreme variation of conditions was necessary for the purpose of research; but the ordinary student was not doing research, nor was it his object to learn in detail about the working of a special machine. His use for the engineering laboratory was to learn generally how to extract from an experiment conducted under severe limitations all the information that it was capable of affording.

The discussion was opened by MR. R. S. BALL, who agreed with Prof. Hopkinson that a multiplicity of small, rough apparatus was much to be preferred to one installation of larger and more perfect apparatus. At Boston they had a large number of students, and a very good equipment; and he was convinced that the best laboratory was that in which the apparatus was not so very fine or expensive.

MR. DUGALD CLERK agreed that a great deal might be done with very simple apparatus. With such there was the advantage that the student had a feeling of personal control. Manufacturers highly appreciated the instruction now being given in the laboratories of this kingdom, and he thought they would all agree with Mr. Ball that the laboratory was as essential to the engineer as the ocean was to the navigator. It was essential that the student should be habituated to the personal conduct of experiments.

PROF. W. C. UNWIN said it was quite desirable in a laboratory to have numerous small sets of apparatus; but larger and more complete installations were also very valuable. Small apparatus sent men into the world with somewhat contracted ideas of the magnitude of engineering problems. His experience was that it was of the greatest value to students to take tests on a large scale, such as the contract tests of large engines; for such a 24 hours' trial would give an impulse to students which no amount of laboratory work with small apparatus would ever impart.

The section of practical training, Section III, commenced proceedings with Prof. Archibald Barr's note or paper on how best to employ the time at college. Prof. Barr put forward the alternatives before the colleges as (*a*) the offering to the student of a general course of study which might form a basis for practice in any department of the profession, and (*b*) the provision of a number of courses, from which the student could select the one best adapted to assist him in his particular line. He did not think specialisation should be attempted, owing to uncertainty of the student as to what his ultimate occupation might be. The question as to the order in which the two sections of the engineer's training should be pursued also admitted of no general answer; there were advantages to be urged both for taking the college course first, and the works course first. On the whole he was inclined to think the shorter period, alternating six months' practical, and six months' college training, the most promising arrangement. He disagreed with the 12 months at termination of college course suggestion.

PROF. HENRY LOUIS'S note dealt with other qualities called forth by a college training, apart from the actual information gained, such as tact, patience, honesty of purpose, and a sense of fair play. Manual skill was in danger of being rated too highly, and was, he thought, a survival of the old apprenticeship system. A college was the place to learn principles, and not practice. He did not find that the sandwich system, in its true form, was satisfactory on the whole, and it frequently resulted in both classes of work being badly done. He was in favour of the method adopted by coal-mining students. They had often had a little experience of practical engineering before they came to college and took a three years' college course, spending their long vacations at a colliery, a portion of the time underground and the remainder in the drawing and other offices. After taking a college degree the law insisted that they should have three years' practical experience underground before they were allowed to take the examination for a certificate as a colliery manager.

MR. H. ROLFE said that so far as manual training was concerned, the cases of the civil and the mechanical engineer were not analogous. For instance, in mechanical engineering a good fit was essential, and the students should be capable of appreciating fine

measurements. As regarded practical training at a college, the drawback was that college students were apt to think that their sole duty was to design a machine mathematically and theoretically perfect, instead of one which utilised standard patterns, and effected the object in view at the minimum possible cost. Costs and estimates also required attention. The importance of quick delivery and low prices was apt to be overlooked in the desire to give attention to scientific points. He was in agreement with the course of training proposed by Sir H. F. Donaldson, which formed an excellent introduction to the drawing office.

MR. W. B. WORTHINGTON, speaking particularly of structural engineering, agreed entirely with Prof. Barr as to the impossibility of a hard and fast rule for every case. There was no need to standardise engineering education on this point. It was clearly best for civil engineers to have their college training before apprenticeship. On taking a boy into his office, he first stipulated for a University qualification. When he had ascertained to what extent ability to draw existed, he put the learner on to structural steelwork to give him experience in design. Otherwise, work spent in attempting to design structures would be waste of time. He assumed that one year would be spent in the workshop, either before or after office. For the mechanical engineer the alternative system was more practical than for those engaging strictly in civil work. Alternations of 12 months' duration were not suited to the working of a civil engineer's office.

PROF. THOMAS TURNER supported Prof. Barr's proposition, but from another point of view. The subject had been under discussion 25 or 30 years without getting any nearer a definite solution. What was required was that students, on entering college, should have some practical knowledge, and also that the value of a practical training should be enhanced by preceding it by a theoretical. They were, therefore, confronted with the problem how to combine the two courses of instruction. The ideal method could be followed by a man who had works of his own, and ample means, and who was putting his sons into the business. They worked nine months at college and three months in the works. After matriculating, they had three months further in the works, then went again to college, and again to the works.

SIR ALEXANDER BINNIE said there was not the slightest doubt that an enormous improvement had taken place both in engineering and education. The results, however, so far as the latter was concerned, were not altogether satisfactory. Speaking as one of the selecting committee at the India Office, he had found that a college training was quite inadequate; it turned out mechanical, but not civil engineers. The workshop was not civil engineering. Many of the men were excellent mechanics, but were not acquainted with the essentials of civil engineering, and needed broader views. His own predilection was in favour of natural philosophy, which made a good foundation. What Prof. Huxley used to call physiography was as important to a civil engineer as geography. There was also a lamentable absence of knowledge of surveying, and of outdoor instruction. A man should go to college and absorb all there was to be learnt there and then get his practical experience. With regard to the skilled use of tools, a man could tell whether a thing was well or ill done without being a riveter. He did wish that a college would fit a young man not for the workshop, but for the world. Let the students know what had been done, and study the actual work of the masters of the profession.

SIR FRANCIS RAEBURN said that the type of man whom they had to consider was the man of average attainments. The exceptionally clever man always got on, and the exceptionally bad dropped out. Education should be in the direction of rendering the mind cultivated and receptive. In the higher branches of engineering a broad knowledge of affairs was necessary. Coming to the question of training an ordinary constructional engineer, he did not think that everyone had time to do much training in the shops. He favoured learning as much practical work as was possible in the college. A marked improvement was noticeable in the intelligence and education of the middle classes of the profession, so much so that a man with a receptive mind might well pick up from his foreman what instruction he needed in the shops. He attached great importance to work done on the administrative side. He summarised his views as to the education of engineers as follows:—(1) A good general education, in no sense specialised; (2) the University training should be good, thorough and scientific, combined with as much practical work as possible; (3) they should get into works pertaining to their own especial branch as soon as possible, making the works course as general as possible.

Mr. I. A. BRODIE, MR. J. M MONCRIEFF and PROF. J. J. WELCH asked that their papers be taken as read. Mr. Brodie's treated of the importance of a course in the drawing office as part of the works training. An insight into the commercial aspect of engineering was also of great value. Mr. Moncrieff treated of the numerous educational advantages which could be acquired in the shops by an observant and painstaking student. Prof. J. J. Welch advocated a preliminary workshop course on leaving school, before commencing college training.

The CHAIRMAN (Mr. R. Elliott-Cooper) asked for the testimony of employers as to the value of the young student in the works, and how far they had been influenced by their training as civil rather than as mechanical engineers.

MR. J. MITCHELL MONCRIEFF, as a civil engineer in private practice, said he had met with no jealousy of college education. He dissented from only one view taken by Prof. Barr, viz., that there were no professors who did not consider their students fit for employment as assistants. Some college authorities certainly did give this impression. No civil engineer could be a wage-earner until he had been on real work. It was no good for the civil engineer to take young men direct from college. On the other hand, it was hard on a graduate of 22 to start his pupilage then. The university could only pretend to give practical teaching. It had not the necessary commercial feeling behind it to attend to this important side of the question.

MR. GERALD STONEY had read the papers with great interest, and welcomed the note as to close contact with the workman. He also was glad to hear Sir Wm. White's remarks as to the one year's "weeding" course. At Messrs. Parsons's works any apprentice could go to college and put in a sandwich course. This could only be done for a few of their 250 apprentices, where about 3 or 4 per cent. took this course. If a larger number wished to do it, it would become impossible.

MR. C. W. DARLEY spoke from the point of view of a civil engineer. In his opinion, the sooner a man got out into practical work the better. In Australia, the tendency was to put engineers in charge of constructional work, instead of letting it out to a contractor. To be fit for this kind of work, a young engineer should have as much time on the works as possible. Experience in a contractor's office for three or four years after the college course was desirable. A large number of the best recent papers read before the Institution had been contributed by non-college men, who had derived their knowledge from actual practical work.

MR. R. J. G. READ said that not sufficient distinction had been made between training for civil and mechanical work. It was a pity for boys to have to go to work immediately on leaving school, they should preferably have from three to six months in the office. He thought that, for civil engineers, it was undoubtedly of great advantage to have a college training, and then go into an engineer's office. The time of apprenticeship might be shorter than formerly, owing to the excellent college training which was now available. He had had several pupils, and found that the college-trained man picked up his work and became a useful assistant sooner than the others.

MR. WALTER HUNTER read an extract from a letter from the municipal engineer at Shanghai, in which the English system of training engineers was referred to as superior to the German and American.

MR. ELLIOTT-COOPER, in closing the discussion, referred to Mr. Burge on training engineers for foreign service. Life was not long enough for a man to study every possible branch of engineering which might subsequently bear on his work. A good broad general engineering knowledge fitted a man for service in any part of the world. Adaptation to the needs of the country in which his career placed him was a matter of a few weeks. Special training could be acquired on the spot. Mr. Benedict had referred to times past in the matter of pupilage. Young engineers now often went to contractors, not to engineers. Money values were often best learnt there. It was a mistake to go straight from college to the contractor's office; they would then miss a good deal of experience in design. As regarded the sandwich system, he thought the college career should precede the practical. He did not go so far as to say that some practical training might not be sandwiched in.

A final meeting of all the sections was subsequently held under the presidency of Mr. Alexander Siemens.

MR. A. F. YARROW, being called upon, said that he did not propose to put forward his points as resolutions, but as embodying proposals on which the Council of the Institution might focus its attention. These were: (1) That the Council be desired to use its influence to secure continuity between school and college courses (2) That with a view to facilitate the above, a closer interchange between scientific scholastic bodies and the Institution is desirable. (3) That an attempt on the part of the Council to systematise the sandwich system is desirable.

MR. SIEMENS said that, while no vote was to be taken on these proposals, they would receive the careful consideration of the Council. He would like to give them his personal impressions of what was to be gathered from the Conference. (1) As regarded general education, school-masters asserted that they did not know what would be the ultimate occupation of the boys whom they were preparing. It would appear that they had forgotten the Conference of six years ago, when the schoolmasters had failed to agree as to what the desired syllabus should be. He hoped that some agreement might be arrived at now. The Surveyors' Institution, for one, had drawn up such a syllabus, for an examination which qualified a man to practise as a surveyor throughout the Empire. (2) As regarded the scientific education, that had been well expressed by Prof. Petavel. The student must above all be trained to learn. (3) With regard to practical training, he was afraid the views of the Conference were contrary to what Mr. Elliott-Cooper had just said. He himself favoured 12 months in the works after a standard examination, then college, and then works again after the degree had been obtained.

Efficiency of Ultraviolet Quartz Lamps.—In the *Revue Industrielle*, Mr. Préval quotes experiments made by Messrs. J. Courmont and Ch. Nogier on the progressive diminution of output of ultraviolet rays by quartz mercury-vapour lamps working at high temperature. The results show that the luminous and ultraviolet efficiency of the lamps is far from constant, the diminution beginning directly they are put in service and going on steadily; the physical, chemical and germicidal properties of the light necessarily fall off correspondingly. The change is internal to the quartz container, and indelible. It is necessary, therefore, in order to prevent this deterioration, to adopt means for cooling the quartz containers while the lamps are in use.

PROCEEDINGS OF INSTITUTIONS.

Tramways and Light Railways Association.

EDINBURGH CONGRESS, JULY 13TH AND 14TH, 1911.

A PAPER on "Transfer Fares" was read by MR. C. W. SHEPHERD, general manager of the Edinburgh and District Tramways. The author declared himself in favour of penny transfer tickets, as used in Edinburgh, on account of the impossibility of running through cars from anywhere to everywhere, and the necessity of meeting the needs of as large a number of passengers as possible. Where halfpenny fares were in operation, he did not consider transfer tickets necessary or desirable. He objected to the exchange ticket system as opening the way to abuse, and preferred a single ticket for the divided journey. The distance covered should be less than that allowed for the same fare on one car.

In the course of the discussion which followed, MR. WM. CLOUGH (Bury) said the transfer fares could only be regarded as necessary evils.—MR. FITZPATRICK (Leith) said that for every additional 100 passengers they carried in Leith the increase in revenue amounted to just over £1, but transfer fares were the lesser of two evils.—MR. DALRYMPLE (Glasgow) also spoke.

MR. G. H. J. HOOGHWINKEL read a paper entitled "A Few Reasons why Electric Traction in England Remains Stationary." In his view, certain features would have to be radically altered if tramway enterprise was to be continued in England on a sound commercial basis. Our tramways cost too much to construct and to run. Light single-deck cars were used practically all over the world, and allowed of cheaper track construction, quicker and more frequent service, less noise, the use of the sliding bow, and therefore cheaper overhead construction, and better supervision by the conductor. The greater space occupied would be of importance only in exceptional cases; the traffic in this country was not more dense than in large towns abroad where single-deck cars were used successfully. Passengers should be allowed to ride on the platforms of single-deck cars. The lighter cars would depreciate the track less rapidly, and the heavier wages bill anticipated was less serious than was imagined. Trailers could be used to great advantage, especially on suburban lines. The English track construction was excessively costly and also unsuitable, for it was a mistake to run heavy rigid tracks on a "would-be" rigid road-bed. A return to an improved flexible track was urgently necessary. Anchors and sole-plates only accentuated the evils of present practice. A concrete bed should only be used where asphalt paving was employed. The rails should rest on wooden sleepers. Other changes advocated by the author were the use of the sliding bow, the greater use of wall rosettes, the use of a flexible truck (Warner type or other), the introduction of "pay-as-you-enter" cars, and the use of trailers.

On the second day, a paper by MR. C. W. MALLINS, general manager of the Liverpool Corporation tramways, was read, entitled "Notes on Tramway Problems." The author referred to the "amazing variation" in the cost of construction of permanent way on different systems—from £3,255 to £9,877 per mile of single track (average £6,719) in the case of 12 typical undertakings, the overhead equipment similarly varying from £640 to £2,788 per mile (average £1,790). The cost of maintenance per mile per annum ranged from £21 to £300 (average £99). The author pointed out the injustice of charging the tramways with the cost of widening the roads, in addition to requiring them to pay rates and taxes and to maintain the road surface. He preferred the single-truck car to the bogie truck, as the former would carry 70 passengers, which was as great a number as a single conductor could attend to. The cost of energy sold to tramways varied more than was justified by the difference in local conditions—from 1·3d. to 2·149d. (average 1·651d.) in the case of 12 undertakings which purchased energy, while it was only from 0·405d. to 0·96d. (average 0·684d.) to 12 undertakings which generated energy for themselves. The continual demand for cheaper fares was becoming one of the most serious problems in connection with tramway management. Certain undertakings which had given preferential treatment on a large scale to various sections of the public had incurred a tremendous loss on that portion of their business. Penny stages varied from 2 miles 40 yards to 2 miles 1,320 yards in the case of eight large undertakings, and from 1 mile 1,115 yards to 1 mile 1,710 yards in eight smaller ones. It was the opinion of experts that even on the largest systems a passenger could not be profitably carried 2 miles for a penny, and on smaller systems the distance would be proportionately less. The annual loss to 29 undertakings through preferential treatment in various forms was £165,000. Much might be done to develop the transport of goods by tramway, affording a saving to the owners and bringing in a revenue of several millions sterling per annum.

In the discussion which followed, MR. C. W. SHEPHERD (Edinburgh) referred to the question of carrying parcels, and said that while he was not an advocate of the carrying of heavy goods on tramways, he had been struck with the amount of profit secured at Dublin in this way. The Edinburgh company had adopted the system, and their experiences had been the experience of Dublin—they were getting 50 per cent. of their seats and parcels as profit. He did not think there was anything so easily managed as a small light parcel express service on a tramway.

A paper by ALDERMAN W. IVEY, of West Ham, dealt with "Tramways and Light Railway Legislation of the Future." Their chief cause of complaint, he said, was that in actual practice the Acts of 1870 and 1896 did not provide facilities for what, in the first instance, was essential, viz., promotion of the powers necessary to bring them to that stage when the Parliamentary provisions for construction, in the first place, and regulation and working in the second, became of any value. If one-half of the money spent in applications had been used for the purpose of laying down installations there would have been a far different aspect to-day. The laws should be made to encourage national industries and not to restrict them. Tramway Bills were usually condemned to death by their accusers, for what other interpretation could be placed upon the local authorities' veto? The most elementary principle of justice demanded the abolition of the veto. Many other desirable reforms were dealt with in the paper.

High-Tension Mining Switchgear.

By F. B. CLARK, B.Sc.

(*Abstract of paper read before the* SOUTH STAFFORDSHIRE AND WARWICKSHIRE INSTITUTE OF MINING ENGINEERS, *July 4th*, 1911.)

HIGH-PRESSURE current tends towards the use of less cumbersome apparatus and cables, and generally in the direction of superior construction; for, whereas medium-pressure apparatus can generally be got to work, however faulty its condition, high-pressure apparatus must be kept in good order, or it cannot be got to work at all. For installations where the power has to be conveyed some considerable distance before it is used, high-pressure alternating current is undoubtly the best. At pressures in the neighbourhood of 3,000 volts, it is advisable to transform down to 500 for motors under 50 H.P., and at higher pressures it is better to reduce the voltage for motors under 100 H.P. This is because there is considerable difficulty in winding a small motor for a high voltage, as it necessitates a great many small wires per slot.

Switches should be capable of breaking with safety and certainty the maximum power which may instantaneously pass through them under any conditions. For use underground, all circuit-breakers should be oil-immersed, even for low pressures; but, at the surface, it is not necessary to use switches of this type for circuits of 500 volts and lower, unless the circuit-breaker controls a large amount of current.

For use both above and below ground, fuses should be avoided, and overload trip-coils employed in their place. Only small lighting circuits and instruments are best protected by fuses. The overload coils are either supplied with current at the same voltage as the circuit, or else small transformers are employed and the coils supplied with low-tension current. The latter method is certainly the more sound, and should undoubtedly be employed in the generating station; but, in order to reduce the number of parts to a minimum, many makers are fitting high-tension tripping mechanisms to switches other than those used in the main station.

No-Voltage Coils should be fitted to switches operating motors that are not under the constant supervision of an attendant, but are left to run by themselves.

For motors under 200 H.P., where a large starting torque is not necessary and speed variation not required, the squirrel-cage type may be advantageously employed. Where the squirrel-cage type cannot be employed, and the motor is to be used for continuous running, it generally has its rotor connected to a liquid starter; these starters may be used for motors driving pumps, endless haulage, fans, &c., but for those that are continually being started, stopped and reversed, as in main-and-tail haulage, liquid starters are not to be commended; the rotor-circuits in such cases should be connected through a controller to metallic resistances, generally of the cast-iron type. In wet and very dusty places, oil-immersed resistances are recommended.

For underground use the horizontal type of controller, with the drum fixed to the cover, is preferable to the vertical type, as the latter, when oil-immersed, does not lend itself so readily to inspection as the former. Controllers should be of the type that cuts off the current completely from the stator when the operating handle is in the "off" position.

Experience has shown that the contact-fingers on air-break controllers do not wear so badly as those on oil-break controllers, owing to the fact that the oil, although it diminishes the arcing, yet concentrates it on one point of the fingers; moreover, since controllers are not of the quick-break type, as are oil-switches, there is more time for arcing. Consequently, although it is better to employ oil-immersed controllers underground to prevent open sparking, it is perhaps advisable to use air-break controllers on the surface; and in this case the vertical type will be found to be more suitable, on account of the ease with which it can be inspected and the small floor space which it occupies.

It is generally advisable where the installation is large, the system extensive, and power is being transmitted from a central generating station to the various collieries, to use some form of automatic leakage protective device, in addition to the overload trip-coils, more especially if aerial transmission is used. The Merz-Price system has been extensively used, and has given excellent results.

In the underground use of electricity simplicity is essential, and the only reason, therefore, for considering whether leakage protective devices should be adopted underground is to prevent external arcing. When cables are conveyed along roads that are dry and dusty, or likely to contain gas, the use of lead-sheathed and armoured cabling, or other double-sheathed cabling, constructed in accordance with the advice given in the Report of the Electricity in Mines Committee (Rule 12, Sub.-Sec. *e*) will do much to prevent external arcing. The safest method is to place them in steel troughing filled with sand, and bury them on the side of the road. By so doing an armoured cable is absolutely safe, for even if arcing does appear outside the armouring, it is still covered by the sand, troughing and earth. If it is not desired to bury the cables, leakage protective devices (preferably of the type which does not need pilot

wires) may be employed to advantage. In such a case it is wise to avoid taking the cables along main haulage roads, and also to avoid high-pressure transmission, as leakage protective devices act better on medium and low-pressure circuits.

Where cables are taken along roads that are naturally wet and free from gas, it is not necessary to bury them or to use leakage protective devices.

One of the leakage protective devices which do not need pilot wires and are suitable for underground use, is that generally called "Wedmore's." Its action is based on the fact that the amount of current entering and leaving the three phases at the supply end must at every instant of time be equal, unless there is leakage; and so it gives an absolute indication of leakage without regard to the balance of power in the three phases.

Underground switchgear for motors and sub-stations should be compact and simple, with a minimum of instruments, absolute protection being more desirable than immediate accessibility. It should be interlocked, so that no part can be got at unless "dead." It should be waterproof, dust-proof and so constructed that open sparking cannot occur, and the details should be accessible when protecting covers are removed. Furthermore, it should have all its parts interchangeable, and should require the minimum amount of attention. To meet these conditions, marble and slate switchboards are being superseded by switchgear completely enclosed in strong metal cases, even for surface use. In order to make the gear more compact, makers have, on the whole, erred on the side of too little clearance. In the generating station more space can be given to each item; it is always an advantage to avoid cramping, accessibility in conjunction with safety being the object in view.

Owing to the unevenness of the load in most colliery work, it is often necessary to employ some form of automatic voltage-regulator. The form that has given the best results is the Tirrell regulator.

Lately ironclad switchgear, very similar to that used underground, has been employed largely for surface sub-stations of small and medium power, while the cellular type has found favour for large power sub-stations.

The writer prefers lead-sheathed, paper-insulated, armoured cables for underground use, although where the pit-water attacks the lead it is better to use cables insulated by vulcanised bitumen, copper-sheathed and armoured.

The question whether it is better to earth the neutral point of a generator or a transformer has often been fully discussed. The conclusion generally arrived at is that for absolute safety it is better to earth the neutral point; but this has one disadvantage, for if a fault develops on one of the three phases of a cable, the faulty cable is immediately cut out, and the motor supplied by that cable cannot be used again until the faulty cable is repaired, unless a duplicate feeder is installed, which is an expensive item. But with an insulated neutral point the motor can be supplied despite the fault, which can be repaired at the end of the shift. Consequently, if duplicate feeders are used, it is advisable to earth the neutral point; but where apparatus is supplied by a single feeder, it will be found better to insulate it from earth. If the neutral is earthed, however, in order to limit the leakage-current to earth in case of a fault, it is desirable to earth through a resistance, which must be able to pass at least enough current to enable the circuit-breaker which has the highest setting to operate, otherwise if a fault developed in that feeder the neutral-point resistance might keep the current down to such a point that the breaker would not cut out the fault. It is advisable to paint each phase a separate and distinct colour, and to keep that colour for that particular phase throughout the entire system. By treating bus-bars and connections in this way, much time and trouble can be saved in rectifying a fault, breakdown, or leakage in any phase. Where high-pressure alternating current is installed, the use of inferior material is foolish in the extreme. The best advice, therefore, should be obtained on the design of an installation and on the purchase of apparatus, and only those firms that have had experience in making such electrical apparatus as is required should be dealt with. It will be found advisable not only to purchase the best apparatus, but to install it with great care and accuracy, and then by intelligent and regular inspection to keep it in good working order.

DISCUSSION.

MR. A. HALL (Nuneaton) wrote that his views, generally speaking, coincided with those put forward by Mr. Clark. In his introduction Mr. Clark, speaking of coal cutters, said:—"There is nearly always some commutation trouble in underground direct-current work." He did not think this obtained to nearly the same extent now as formerly. Having had to do with the working of direct-current coal cutters for over a dozen years, he could testify to the fact that nowadays there was very little commutator trouble experienced, as the vibration had, he thought, been brought down to about the minimum. He agreed that direct-current coal cutters did possess an advantage over those driven by alternating current—even if the starting torque alone was considered. He was also in entire agreement with the earthing of the neutral point; to his mind the advantages of so doing greatly outweighed the disadvantages. He agreed mostly with Mr. Clark's views on the cable question, but, unfortunately, some of the suggestions were somewhat difficult to carry out satisfactorily. For instance, in a great many collieries it would be almost absolutely impracticable to keep intact the buried steel troughing filled with sand, and containing the cable—however effective it otherwise might be. Again, it would be decidedly risky to put cables in a steep haulage incline, which might be of restricted sectional area. In such a case the danger of damage by reason of runaway or derailed tubs would be very great. On the other hand, there were many collieries where circumstances would make it very inconvenient to carry the cables entirely in the returns, so that any hard and fast rule on the subject could not be made generally applicable. Personally, he had always considered the cable danger to be the greatest in underground electrical work, the switchgear, to his mind, being secondary. He was of opinion that the last paragraph of Mr. Clark's paper was the most trenchant and powerful one of the whole. The installation only needed to be adequately carried out to ensure the satisfactory and successful working of electricity underground, with a high factor of safety.

Owing to lack of time, further discussion was deferred.

The Faraday Society.

ALLOTROPIC FORMS OF METALS.

THE Faraday Society closed its session on June 13th with a lecture by PROF. ERNST COHEN, of the University of Utrecht, on "Allotropic Forms of Metals." Mr. G. T. Beilby, F.R.S., was in the chair.

It is generally supposed that only very few elements can exist in allotropic forms, but the researches of the past few years, researches in which Prof. Cohen and his colleagues have played a notable part, make it appear probable that allotropy is a property of most, if not all, of the elements. As regards the metals, only three or four cases of allotropic forms have up to the present been studied, notably iron, tin and antimony, although modified forms of zinc and lead are also known to exist. The theory of the existence of α, β and γ forms of iron is of course at the basis of the modern theory of the constitution of steel, but Prof. Cohen mainly confined his attention to the less well-known varieties of tin and antimony, and his account of the properties of the different forms of these metals was of exceptional interest, whether from the theoretical or practical standpoint.

Thanks to recent advances in our knowledge of chemical and physical equilibrium, it is now possible to understand the phenomena of allotropy much more clearly than was the case some years ago. Take the case of tin, for example. Here the equilibrium conditions are exactly similar to those obtaining between ice and water. It is only at one definite temperature, 0° C., that ice and water are in equilibrium together. Above that temperature only water can exist; below it only ice, in a stable form. Water, it is true, may be cooled below 0° C. without solidification setting it, but its condition is then unstable, or *metastable*, and if a fragment of ice be thrown into the water, complete transformation to ice immediately follows. So with tin. We have the ordinary white reguline variety existing above 18° C. and the grey powdery form existing in a stable form below that temperature. It is clear, therefore, that, if ordinary tin be cooled below 18° C., it will be in a metastable condition, and a gradual change to the grey powdery variety is bound, sooner or later, to set in.

The mysterious appearance of this grey powder or *tinpest* on articles made of tin has for long been the source of much speculation as to its cause, and Prof. Cohen showed at the meeting some striking examples and illustrations of the very strange way in which old objects of tin have at last succumbed to the disease that must in time inevitably follow cooling below the fatal transition temperature of 18° C. Thus, on certain organ pipes, many centuries old, strange excrescences gradually made their appearance, and in time some of the pipes entirely fell to pieces. A Roman vase in the British Museum, some 2,000 years old, has recently shown signs of distintegration, and the cause is likewise to be ascribed to the fact that the vase is made of tin, and the transition to the grey form has at last set in. The pest has lately been observed in some American tin cans containing preserved food, with a result that the iron base of the tin sheet was laid bare and electrolytic action set up, which perforated the can right through. This was the result of keeping the tinned food in a refrigerating chamber, and a general appreciation of the phenomenon of "tinpest" is, therefore, of great public importance.

The explosive variety of antimony was discovered many years ago by Dr. G. Gore, of Birmingham, but it has only recently been studied from the point of view of equilibrium conditions. Unlike tin, in the case of antimony there is no transition temperature at which the two forms are in equilibrium; the explosive form is always "metastable," and at every temperature tends to change into the ordinary stable form. Explosive antimony is prepared by electro-deposition from the chloride, bromide or iodide solutions, and there is always a small quantity of the salt present in the deposited metal in a state of solid solution. If a solution more dilute than about 4 per cent. be used, the metal does not come down in the explosive form. When a rod of explosive antimony is scratched, it immediately returns to the stable form accompanied by a great evolution of heat that sends the temperature up to about 370° C., but if left to itself the explosiveness will gradually disappear, the metal slowly changing to its normal form.

Electricity in Cyaniding.—The *South African Mining Journal* learns "that some experiments in connection with the application of electricity to cyaniding are being carried on by a private syndicate at a site of the old Stanhope Works. The trial is said to have reference to the hastening of the time in which the gold is dissolved."

MISCELLANEOUS LAMP CHARACTERISTICS.

By M. TAPPLEY.

(*Concluded from page* 112.)

In carbon and "flame" arcs, however, wholly different conditions are met. The main difficulty is that the candle-power is constant neither in maximum nor mean value nor in distribution; the rapidity of its variation in every respect is so great that it is with extreme difficulty that any consistent arc lamp observations can be made. It naturally follows that extraordinarily high candle-powers may be *momentarily* observed during tests on any arc, and, in the early days of arc lamp development, makers carefully sought after these "snatch" readings, and, obtaining from them extraordinary efficiencies, promptly adopted the latter as the basis of their standard lamp ratings. These, correct and legitimate so far as they went, were, like the data on which they were based, "snatch" ratings, and the fictitious significance attached to them led to the development of what was practically an arbitrary system of rating. Thus for a number of years a "2,000-C.P." arc lamp consumed 400-500 watts, and was really of about 750 M.H.-S.C.P. Such a state of affairs naturally caused much confusion, not to say deception, and it is fortunate that makers and consumers alike now realise the advisability of a straightforward rating, based on M.S.C.P. or M.H.-S.C.P., *measured under normal and definitely stated conditions*. The necessity for the italicised clause will be apparent from the following data. A certain Westinghouse-Bremer flame arc gave efficiencies:—

	With globe.	*Without globe.*
Watts per maximum C.P. ...	0·180	0·081
" M.H.-S.C.P.	0·287	0·133

The possibility of accidental misunderstanding or wilful misrepresentation of these figures, were the conditions of their application not definitely stated, needs no explanation.

Mean hemispherical candle-power is a convenient and usual rating for most arc lamps since the commonest application of the latter is to street lighting and similar duties, in which any light leaving the complete lamp (including its globe and reflector fittings) in an upward direction is useless. Otherwise the mean spherical C.P. is the rating to be employed: the candle-power in any individual direction is of no real value, though the *maximum* C.P. of an arc is often cited (it is, alone, of no value, but is an interesting figure and one which forms a useful "catch" number for advertising purposes).

The ideal rating for lamps of every kind would include a polar diagram of candle-power distribution and the mean horizontal, mean hemispherical and mean spherical candle-powers of the unit, together with a sufficient explanation of the conditions under which these were determined. Such a complete rating can hardly be generally expected as yet, though many makers—particularly of arc lamps—closely approach it.

The advisability of substituting a wattage for a candle-power rating has been widely discussed (especially in connection with metallic-filament lamps), and though the addition of the wattage to the candle-power rating would be extremely valuable in all cases, it is hardly desirable to allow its substitution for the latter.*

An interesting attempt to obtain a rating figure, which should indicate the illuminating value of arc lamps, was inaugurated by the National Electrical Association (America) in 1908. The rating number for any particular arc was defined to be the ratio of 250 ft. to the distance at which a 16-C.P. lamp would give the same normal illumination (as given by the arc at 250 ft.). This rating does not take account of the polar distribution of the lamp, and might easily rate unfairly such lamps as the intensive gas burner, the American Nernst lamp, the Jandus arc, and others in which a special distribution suitable to particular services is deliberately arranged. While inferior to a M.H.-S.C.P. or M.S.C.P. rating—particularly if the latter be accompanied by a typical distribution curve—the N.E.A. rating has the merit of simplicity, and should certainly be employed in preference to the old arbitrary "nominal candle-power" ratings. Typical rating numbers, determined on the above basis, and published by the N.E.A., are:—

TABLE III.—N.E.A. RATING NUMBERS.

	Type of lamp.	*Amperes.*	*Rating number.**
D.C.	Series magnetite	4·0	5·5
D.C.	" open	9·6	4·0
D.C.	" enclosed	6·6	4·0
A.C.	" "	7·5	4·0
A.C.	" "	6·6	3·5
D.C.	" open	6·6	3·5
D.C.	" enclosed	5·0	3·5
A.C.	" "	5·5	3·0

* If a lamp has a rating number = 5, the interpretation intended is—the normal illumination due to the lamp at a distance of 250 ft. equals that due to a 16-C.P. lamp at 50 ft.—an interpretation clear enough in itself but obviously vague in its absolute meaning.

Candle-Power of Units.—This is, of course, largely determined by the candle-power *desired* in various applications, yet more or less standard candle-powers have been evolved to suit convenience of manufacture and utilisation: candle-powers, that is, which are employed to a far greater extent than those of intermediate value. In Table IV are given the most usual candle-powers of various filament lamps and the approximate candle-powers of various arc lamps (which, however, vary enormously in size and type, and are usually built for standard *current capacities;* since the terminal voltage is fixed in each case, this amounts to a wattage rating). Working on a current basis, the M.H.-S.C.P. of various arc lamps is much as follows, the lower limit being approached by A.C. and the upper by D.C. lamps:—

Open arcs (pure carbons) ...	50—100	M.H.-S.C.P. per ampere.
Enclosed arcs (pure carbons)	60—120	" "
Flame arcs, white	180—250	" "
" " yellow	250—300	" "

TABLE IV.—CANDLE-POWER OF LAMPS.

Type.	Usual C.P.
Carbon-filament	8, 16, 32, 64, 100, 200 M.H.C.P.
Metallic-filament	20, 50, 100, 200, 400 M.H.C.P.
Nernst filament	40, 100, 250 M.H.-S.C.P.
Mercury arc (low voltage)	400—500 (3½ amps.), 1,600
" " (quartz)	(10 amps.) M.H.-S.C.P.
Moore tube	10—12 per ft. run
Open arcs	750—1,000 M.H.-S.C.P.
Enclosed arcs	500—800
Flame arcs (vertical)...	500—1,000 (mean 800)
" " (inclined)...	1,500—5,000 (mean 2,500)
10-amp. open arcs (D.C.)	800—1,000 M.H.-S.C.P.
5-amp. enclosed (D.C.)	500
10-amp. flame arcs (D.C.)	2,500—3,000
Bremer flame arcs, with globe ...	1,500
" " without globe ...	5,000
Aurola flame arcs	3,000
Average small arcs, open, no globe ...	300—500 M.S.C.P.
" " open, with globe	230—430
" " enclosed, no globe	200—250
" " enclosed, with globe	150—200

Ageing, Burning Hours, &c.—It is well known that gas mantles and electric filament lamps deteriorate in candle-power as they grow older; this decadence is generally referred to as "ageing."

There will clearly be a critical state of decay—varying with the initial cost of the lamp, its wattage and the price of energy—at which it would pay to discard the lamp (or mantle) in favour of a new one; the cost of renewal being balanced by the increased light obtained. This "economical life" is merely that which gives a minimum average cost per C.P.-hour, allowing for all renewals, &c.

In the case of carbon-filament lamps, the deterioration is comparatively rapid, and usually, after some 800-1,000 burning hours, the candle-power of the lamp has fallen some 20 per cent. below its initial value, and the ultimate life of the filament being (frequently) still far distant, it nevertheless pays to scrap the lamp on the above grounds. The life of a gas mantle is, however, so very curtailed that it does not pay to seek a "smashing point"; the considerable drop in candle-power which occurs as the mantle ages (see

* For a more detailed discussion of this matter the reader may refer to ELECTRICAL REVIEW, January 14th, 1910, pages 76, 77.

fig. 1) is mainly confined to a very rapid decadence occurring in the first 100 or even 50 hours of life—a fact which further discounts the advisability of any deliberate smashing. On the other hand, the life of metallic-filament lamps, though still less than that of carbon-filament lamps where low candle-power, high voltage units are concerned, has been

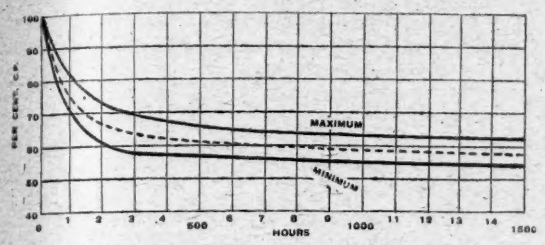

FIG. 1.—AGEING OF INCANDESCENT GAS MANTLES.

so far extended that the necessity for discarding must be considered. It is found, however, that the decadence in candle-power is so small in the case of many metallic-filament lamps (see fig. 2, which is, however, unduly severe on tantalum lamps) that, in view of the high cost of renewals, most lamps of this type are best "burnt to destruction," *i.e.*, run till failure occurs naturally.

Experiments with the latest metallic-filament lamps have shown that after 1,500 hours' life the candle-power may be only 3 per cent. to 4 per cent. below its initial value, and to detect

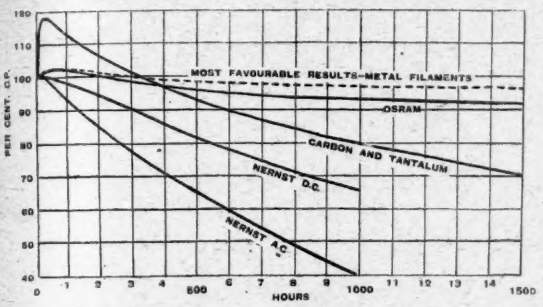

FIG. 2.—AGEING OF GLOW LAMPS.

such a decadence at all clearly requires considerable care in testing. Photometric errors of 2 per cent. to 3 per cent. being quite common, the mere margin of experimental error might lead to the rejection or retention of a metallic-filament lamp many hours too soon or too long respectively.

Tungsten metallic-filament lamps and incandescent gas mantles may well be used till they fail naturally, but carbon-filament lamps may economically be replaced after their candle-power falls to, say, 80 per cent. of its initial value. Tantalum lamps on direct current may be rejected when their candle-power falls to, say, 85 per cent. of its original value, but on alternating-current circuits they should be burnt to destruction. In many instances, however, glow lamps, even when deteriorated as above, give ample light for the purpose required, and in such cases it would be absurd to deliberately scrap the lamp.

Where minimum cost per C.P.-hour is to be attained, "scrapping" may be practised under the above limitations, but where the desideratum is a maximum number of "sufficient light-hours" for a given expenditure, lamps (so long as above the critical sufficient candle-power) should be used till natural failure occurs. In many cases, lamps discarded from situations subject to the first requirements can be utilised in those coming under the second.

The deliberate discarding of lamps, particularly by users not possessed of photometric or other means of judging luminous decadence or cognisant of the peculiarities of various types, is a practice to be adopted with extreme caution.

The following formula for the most economical life of a filament lamp assumes constant wattage and steady decay of candle-power (see fig. 2): it may be applied to gas mantles by the substitution of appropriate units, though its accuracy is somewhat impaired by the non-linear candle-power decay in this type of source (fig. 1).

$$\text{Best life}^* = \frac{1{,}000 \cdot k}{p \cdot \text{W}} \left(\sqrt{1 + \frac{0{\cdot}002\ \text{C} \cdot r}{k \cdot s}} - 1 \right) \text{hours},$$

where W = wattage of lamp; p = pence per B. of T. unit; k = cost of lamp (pence); C = initial candle-power; c = candle-power after t hours; $r = p \cdot \text{W} \cdot t$.; $s = (\text{C} - c)$.

The working life of gas mantles is usually about 350 hours; of carbon-filament lamps 800-1,000 hours, and of metal-filament lamps till breakage occurs—a somewhat indeterminate and chance-governed period, usually varying from 800 to 1,200 or even 2,000 hours.

Though arc lamps, of the carbon or flaming types, are free from any decadence in candle-power, this immunity must be balanced against the cost of "trimming" and supplying their carbon consumption. The burning hours of arc lamps can be almost indefinitely extended by the use of "magazines" containing spare carbons, but for single-carbon lamps, which are still the most commonly employed, 10-15 burning hours are usually obtained in open arc types, 10-12 hours in "flame" lamps and 100-150 or even 300 hours in enclosed lamps. In the case of enclosed arcs it is not advisable to go above 150 burning hours since the globe becomes very foul if left longer unattended, and when opening the lamp for cleaning purposes it is a simple matter to re-carbon its holder.

The candle-power of the Cooper-Hewitt mercury arc lamp falls to about 75 per cent. of its initial value after 1,000 burning hours (mainly owing to a grey film deposit inside the tube) while the quartz pattern has a guaranteed life of 1,000 hours with inappreciable deterioration. Owing to the high cost of both these types, they should be used till natural failure occurs and then returned to the makers in part payment for renewals.

The Moore lamp does not appear to age appreciably, but its breathing valve and phosphorus chamber require overhauling and replenishing once in one or two years, the tube itself being inspected, cleaned and blown through at the same time. Those tubes employing carbon dioxide require more frequent attention.

Supply Characteristics. — The most important supply characteristic, where electric lamps are concerned, is the voltage applied to the lamp terminals. Few lamps can stand variation in the latter without serious change in efficiency and candle-power and even refusal to operate or destruction. The candle-power of filament lamps is very susceptible to voltage changes, and in general the relationship between these quantities may be expressed by an equation of the type—

$$\text{C.P.} = \text{K}\ \text{V}^n,$$

where C.P. = candle-power; K = constant; V = terminal volts; and n is an index having the following values for various materials (almost independent of the actual filament size).

	Normal value of n over commercial voltage ranges.	n at abnormally low voltages.*
Ordinary carbon	6·0	7 —8
Metallised carbon	5·0	5 —6
Tantalum	3·5—4·0	4 —4·5
Osmium	3·5—4·0	4 —6
Tungsten	3·5—4·0	3·5—4

* Say 20 per cent. below normal, but filament still incandescent.

Ordinary arc lamps require comparatively close voltage regulation for their satisfactory operation: a certain critical voltage for mercury arcs, 13 volts; magnetite arcs, 30 volts; carbon arcs, 36 volts, must be exceeded, but excessive pressures must be avoided or the automatic feeding coils will give long, unstable and inefficient arcs. The actual average voltages, required by various arcs are shown in Table V, and, though small variations produce a less evident effect than is the case in filament lamps, the rated supply voltage should be adhered to as closely as possible.

Tube lamps employing a mercury arc need a tilting device to strike the arc mechanically or a momentary high-tension discharge to complete the circuit; thereafter a certain critical voltage must be exceeded, but (in the case of the mercury arc) the maintenance of the rated current flow is the important factor controlling the efficiency of the

* For minimum cost per C.P.-hour.

TABLE V.—Voltage and Current Characteristics.

Lamp.	Voltage across Arc.*	Voltage across Terminals.†	Current, Amperes.	Remarks.
Open carbon arc	35-40‡	circa 50	5 to 10	Miniature arcs are being replaced by metallic-filament lamps: 6-7 amp. arcs popular in America.
Enclosed ditto ...	70-80‡	circa 100		
"Carbone" arc ...	90-95	100-120	10	Usual size.
Flame (impregnated)	30-40	40-50	5 to 10 & 10 to 20	Two usual ranges of size.
Magnetite	60-65	90	4	Comparable with enclosed rather than with open arcs.
Titanium	50	60	4	
Cooper-Hewitt mer.	circa 30	50	3½, 7, 10	Three usual sizes.
Quartz mer.: Starting	25-30	200	10	—
" " Running	180	200	3½	—
Moore Tube	—	10,000-12,000	0·3	—
Filament lamps.—			*Amperes per c.p.*	100 volts chosen for simplicity and ease of conversion. Current varies inversely with voltage. For usual candle-powers see Table IV.
Carbon (4w./c.p.)	—	100	0·040	
" (at 2½ w./c.p.)	—	100	0·025	
Metallic (at 1½ w./c.p.)	—	100	0·015	
" (at 1 w./c.p.)	—	100	0·010	
Nernst (at 1 w./c.p.)	—	100	0·010	

* This voltage amounts almost to a physical constant in each case.

† This voltage may be varied to suit supply and circuit arrangements.

‡ Lower voltage generally required on A.C. than on D.C. circuits; also a lower terminal voltage is allowed for series than for parallel running.

lamp, the voltage required varying with the temperature of the tube. Like other arcs, the mercury lamp requires a ballast resistance. In the case of the quartz lamp, the different voltages required during starting and normal running are automatically obtained by using an iron ballast resistance. Instead of running the latter permanently at near red heat (as in the Nernst lamp), it is run thus only during starting; its high resistance then absorbs 130 volts, but as the lamp heats up, its own resistance rises, cuts down the current flowing, and thus enables the iron ballast to cool and absorb, by its then much lower resistance, only about 14 volts.

The Moore lamp is essentially a high-voltage type, and, requiring about 10,000—12,000 volts at its terminals, is naturally supplied through a step-up transformer from 100—200-volt A.C. mains. The terminal voltage doubtless affects the efficiency of the lamp, though to just what extent appears uncertain.

The usual current capacities of various lamps are also included in Table V as a matter of interest and, in some cases, importance. No special comment is needed on these figures.

Frequency.—The highest frequencies usual on commercial supply circuits (say 150 cycles per sec.) have no adverse effect on the efficiency or working of electric lamps; on the other hand, if the frequency falls much below 30 cycles / sec., flicker is almost certain to be noticeable in the resultant illumination. This is so intolerable that 25 cycles / sec. forms the lowest frequency at which the lamps at present in use can be operated (apart from any inherent properties of the lamp).

There appears to be little advantage in working at frequencies above 60 or 100 cycles per sec., and, indeed, A.C. arc lamps, however carefully constructed, are liable to operate noisily on circuits of higher frequency than, say, 70 cycles / sec. Filament lamps are necessarily (owing to the frequencies available), but without harm, often worked at 100, 120 or 150 cycles / sec., and the mercury arc may be operated on such circuits, though a lower limit is usually desirable.

From 50-70 cycles / sec.* thus appears to be a convenient frequency for lighting circuits in general, and particularly for arcs (open, enclosed and flame) and Moore lamps.

* Such a frequency has the added advantage of being more suitable for motor circuits than 100 or more cycles / sec. supply.

Power Factor.—It is not generally realised how considerably a purely lighting load may depart from unity power factor (on A.C. supply). The power factor of filament lamps is practically 100 per cent., but few arc lamps have a higher power factor, terminal to terminal, than 85 per cent., or rarely 90 per cent., while in many instances this figure falls to 70 per cent.; the power factor of the arc itself is usually 85-90 per cent. In general, 80 per cent. may be assumed for the power factor of the whole arc lamp, and 90 per cent. for that of the arc alone. The power factor of a mercury arc is from 80 to 85 per cent., while that of a Moore tube may be 90 per cent. or more. Needless to say, these facts must be allowed for in the layout of any arc-lighting scheme.

Conclusion.—The only conclusion the author deems to be necessary is a further apology for the somewhat heterogeneous nature of these notes, and a reiteration of their utility as vindication for their assemblage.

THE PHASOPHONE.*

In spite of the excellence of modern cable construction, it is probable that 99 per cent. of the total cessations of high-tension supply are attributable, directly or indirectly, to insulation failures on the mains. It has been recognised for some time that an insulation test at double the normal working pressure does not sufficiently cover the risks of practice and tests at triple pressure have, therefore, been adopted in many cases. Unfortunately, such vigorous tests are liable to injure the cable permanently, and this without infallibly detecting defects at the time of the test.

The water submersion test for proving the continuity of the lead sheathing on cables (a method too well known to need recapitulation), has two serious defects:—(*a*) It is difficult to test the extreme ends of the cables by this means; (*b*) The lead sheathing frequently has fissures so fine that moisture does not penetrate them to a dangerous extent till the cable has been exposed to damp for weeks or months. (Damaged insulation due to soil subsidence is another prolific cause of gradual breakdown on high-tension

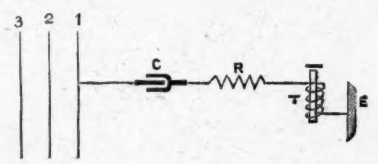

Fig. 1.

cables.) It is thus impossible to ensure perfection in lead-sheathed cables before installation, and what is needed is a device which shall enable the detection of faults before these become absolute. In spite of the fact that the breakdown of a high-tension cable is usually a gradual process—minute sparks slowly heating and destroying the insulation at the faulty place, till at length a "power" discharge occurs—all alarm devices hitherto in use have merely signalled the completion of a fault. By the time such an alarm is

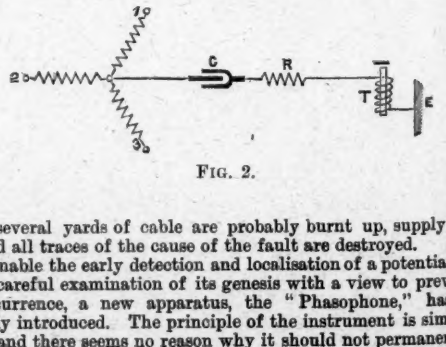

Fig. 2.

given several yards of cable are probably burnt up, supply is cut off, and all traces of the cause of the fault are destroyed.

To enable the early detection and localisation of a potential fault, and a careful examination of its genesis with a view to preventing its recurrence, a new apparatus, the "Phasophone," has been recently introduced. The principle of the instrument is simplicity itself, and there seems no reason why it should not permanently do all that is claimed for it. The essential components are a high-tension mica condenser C, a non-inductive resistance R (of over one megohm resistance), a spark micrometer *f*, and a telephone receiver T. The manner of connecting these is shown diagrammatically in fig. 1, the actual arrangement being as in fig. 3 (which is a plan of the essential parts of the apparatus; dotted connections are internal; low-tension terminals are shown by single and high-tension terminals by double rings).

* Abstract from *L'Industrie Electrique*, May 25th, 1911, pages 250-252.

Referring to fig. 1, the condenser, non-inductive resistance and telephone are connected in series between one line wire and earth. The capacity current then flowing through this auxiliary circuit sets up a note in T, of pitch dependent on the frequency of the main current. So long as the whole installation is in perfect order, the note emitted by T is uniform, but, should the slightest irregularity arise (such as current leakage, sparking to earth, bad contacts, faulty operation of paralleled machines, load oscillations, unbalanced phases, excessive discharge at spark gaps and so on), indication thereof is at once given in a definite and recognisable manner in the phasophone.

The current taken by the phasophone at 5,000 volts line pressure corresponds roughly to an equivalent resistance of 15 million ohms, so that the leakage or sparking at any fault offering less than 15 megohms resistance strongly affects the telephone note. Other faults of a similar magnitude are as easily detected.

The connections shown in fig. 2 are quite permissible, but are seldom employed, it being found that all possible derangements are notified by the arrangement of fig. 1. The most frequently required connections are shown in fig. 3 (also fig. 1); these enable

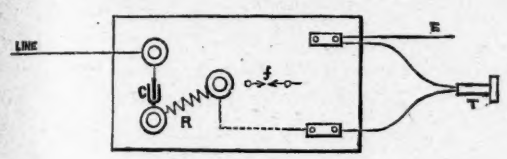

FIG. 3.

the examination of an A.C. network for the correct working and satisfactory condition of all rotary machines, transformers, cables and switchgear connected. Indication of any irregularity is given long before the latter becomes dangerous. It is obviously necessary to secure a good earth contact or the phasophone will indicate its own fault!

Aerial transmissions are examined as readily and as perfectly as underground networks and, where the phasophone is employed, it has been found possible to dispense entirely with the tedious and unsatisfactory process of sending out linemen with field glasses to inspect insulators for cracks or other defects.

The telephone (fig. 3) may be at any reasonable distance from the rest of the apparatus, and it is quite practicable for the engineer in charge to examine the condition of his installation from his office or private residence.

PARLIAMENTARY.

The Use of Electricity in Mines.

STANDING Committee B of the House of Commons has been engaged for several sittings in considering the Government Coal-mines Bill, Clause 60 of which is as follows:—"(1) Electricity shall not be used in any part of a mine where, on account of the risk of explosion of gas or coal dust, the use of electricity would be dangerous to life, and if the owner of a mine, on being required by an inspector of the division not to use, or to desist from using electricity in the mine or any part thereof on such ground as aforesaid, refuses to do so, the question as to the application of this section to the mine or part thereof shall be settled in manner provided by this Act for settling disputes. (2) The use of electricity in any mine shall be subject to general regulations under this Act."

At the sitting of the Committee last week, MR. WALSH proposed an amendment to this clause with the object of restricting the use of electricity to those parts of the mine where safety lamps were not in use.

MR. WADSWORTH said he thought that the use of electricity in mines should be prohibited entirely.

MR. LAURENCE HARDY, speaking against the amendment, said he believed that if it were adopted it would lead to the withdrawal of safety lamps from mines where they were not imperatively necessary.

SIR A. MARKHAM said the amendment, if it were carried, would mean that nearly every mine where the pumping plant was worked electrically would have to be shut down, and that was unthinkable. Such plant was to be found in many collieries in South Wales, but there was only one recorded case where an electric spark had ignited gas.

MR. J. WILSON dissented from this view, and said that the disaster at the West Stanley mine was entirely due to electricity.

MR. E. JONES said that while he thought that electricity should be used for signalling and lighting the bottom of the pit-shaft, he thought it should be absolutely forbidden as a means of working haulage and coal-cutting machinery at the face.

MR. S. ROBERTS hoped the amendment would not be carried, for if it were, electricity would be swept out of every colliery where safety lamps were used, and that would apply to nearly every mine in the country.

On a division the amendment was defeated by 26 votes to 13.

SIR A. MARKHAM moved the following amendment: "(1) If in any place of a mine, or part of a ventilating district of a mine, the amount of inflammable gas in the air currents exceeds one-half per cent. or upwards, the use of electricity shall at once be discontinued in such place or part of such ventilating district where the inflammable gas exists till the air current is clear of the same, or shall not exceed one-half per cent. A hydrogen or other type of safety lamp approved by the Secretary of State, in which low percentages of gas can be readily observed, shall be provided and used for testing for inflammable gas at least twice during every working shift by a competent person appointed by the agent or manager at the place or places where electricity is used, and a daily record signed by the aforesaid competent person or persons shall be kept at the mine of all such tests and the occasions on which, in accordance with this rule, it has been found necessary to discontinue the use of any electrical plant. (2) Every person appointed to work, supervise, examine, or adjust any apparatus shall be competent for the work that he is set to do. No person, except an authorised person or a competent person acting under his immediate supervision, shall undertake any work where technical knowledge or experience is required in order adequately to avoid danger. (3) On and after the passing of this Act a person shall be appointed in writing by the owner, agent, or manager to supervise the apparatus. The person so appointed, hereinafter called 'the electrician,' shall be over 21 years of age; if necessary, the owner, agent, or manager shall appoint for the proper fulfilment of the provisions of this section an assistant or assistants to the electrician. (4) The electrician shall be in daily attendance at the mine; he shall be responsible for the fulfilment of the following duties, which shall be carried out by him or by an assistant or assistants duly appointed under sub-section (3) of this section:—(*a*) The thorough examination of all apparatus (including the testing of earth conductors and metallic coverings for continuity) as often as may be necessary to prevent danger; (*b*) the examination and testing of all new apparatus, and of all apparatus removed from one position in the mine to another before it is put into service in the new position; (*c*) the electrician shall keep at the mine a log book made up of daily log sheets kept in the prescribed form; the said log book shall be produced at any time to an inspector of mines; (*d*) should there be any fault or leakage of current in any circuit the part affected shall be made dead without delay and shall remain so until the fault has been remedied; (*e*) inflammable or explosive material shall not be stored in any room, compartment, or box containing apparatus or in the vicinity of such apparatus. (5) Where electricity is used for signalling, the pressure in any one circuit shall not exceed 25 volts. (6) A proper plan on the same scale as that kept at the mine in fulfilment of the requirements of this Act shall be kept in the office at the mine, showing the position and size of all fixed apparatus in the mine. The said plan shall be corrected as often as may be necessary to keep it reasonably up to date and it shall be produced to an inspector of mines at any time. (7) Haulage by electric locomotives on the overhead trolley wire system is prohibited in any part of a coal mine." He said that his object in moving the amendment was that the use of electricity in a mine should be made subject to the same standard as was imposed in respect to naked lights. He felt confident that if the amendment was carried they would see an end to nearly all explosions in mines resulting from electricity.

MR. HUNTER said that on behalf of the Government he could not accept the amendment so far as the use of electricity at the face of a mine was concerned. If carried, the proposal would practically amount to its prohibition, not only in regard to all mines where safety lamps were used, but also in those collieries where naked lights were employed. It would be practically impossible to enforce the proposed condition, and he hoped the hon. member would allow them to deal with the matter by regulation.

The amendment was agreed to on a division by 15 votes to 12.

A new sub-section was added to the Bill providing that when any question arising under this section had to be settled by arbitration, the owner of the mine, pending the settlement of the matter, should comply with the requirements of the Inspector, subject to an appeal to the Chief Inspector.

The clause as amended was ordered to stand part of the Bill.

Bills Advanced.—On July 19th, in the House of Lords, the East Kent Electric Power Bill was read a third time and passed.

After several sittings, the Committee of the House of Lords, under the Chairmanship of Lord Welby, which had been considering the Tramways and Improvements Bill of the L.C.C., ordered the Bill, with slight amendments, to be reported to the House.

International Electrical Congress.—Official delegations to the Congress to be held at Turin in September have been appointed by the Institution of Electrical Engineers and various other leading electrical societies; membership of the Congress can be obtained on payment of 20s., and this ensures the receipt of the doubtless valuable record of the proceedings, even if a member is unable to attend in person. In view of the importance of the occasion, it is hoped that many British engineers will either attend, when they will be amply repaid for their trouble by the professional and social advantages offered, or will, at least, support the Congress by forwarding their subscription to Mr. Semenza, who is so favourably known to many of our readers.

Rochdale Electricity Supply.—The Electricity Committee, on the 20th inst., decided to adopt a recommendation that the flat rate for lighting be reduced from 4½d. per unit to 4d. It was explained that it would mean a loss to the department of £700. Some time ago a reduction, involving £1,000 a year loss to the department, was made on energy supplied for tramways.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

JAPAN.—As the result of a new commercial treaty between Germany and Japan which came into force on July 17th (the date of operation of the new Japanese Tariff), the following reductions in the duty leviable in Japan on certain electrical and similar goods have been made; the reduced rates will be applicable to British goods in consequence of most-favoured-nation arrangements:—

	Old rate. Yens per 100 kin.	New rate. Yens per 100 kin.
Gas engines, petroleum engines and hot air engines, each weighing more than 5,000 up to 50,000 kg.	5·00	4·50
Each weighing more than 50,000 and up to 100,000 kg. ...	5·00	4·00
Each weighing more than 100,000 kg.	5·00	3·50
Dynamos combined with gas engines, petroleum engines or hot air engines.		
Each weighing more than 10,000 and up to 50,000 kg. ...	5·80	5·50
Each weighing more than 50,000 kg. and up to 100,000 kg.	5·80	5·20
Each weighing more than 100,000 kg.	5·80	4·90

AUSTRALIAN COMMONWEALTH.—The following decisions as to the duties to be levied on certain electrical and similar goods have recently been issued by the Australian Customs Authorities:—

Electrical appliances, &c.:	
Mercury arc rectifier, mounted on a board with other apparatus	20 per cent.
Spare tubes for above, if imported separately. (As electric vacuum tubes)	Free
Electro-medical apparatus, for utilising currents from dynamos, for galvanisation, electrolysis and faradisation. (As an electro-medical apparatus)	10 per cent.
Lamps, switchboard signal	Free
Lamp caps, lamp sockets, and lamp cap guards, for above	Free
Ear-phone, globe	10 per cent.
Meters, electric current	Free
Morse telegraphic instruments of brass, *e.g.*, keys, sounders, &c.	25 per cent.
Bells, electric, if of brass or gun-metal	25 per cent.
Holders, brush, for dynamo-electric machines	20 per cent.
Draegerwerk rescue apparatus for mines.	
Accessories therefor, as under, imported separately:	
Accumulators for lamps	Free
Electric safety lamps (self-contained)	15 per cent.
Flying telephone station	Free
High-pressure refill pump (if security furnished)	Free
Transportabler Wechselstrom Anschlussapparat, an electrical appliance used by doctors	Free

N.B.—The rates given above are in all cases those of the British Preferential Tariff.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expresaly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

15,933. "Control of electrically-operated lifts, elevators and the like." H. C. WALKER and R. WAYGOOD & Co., LTD. (Divided application on 20,118/10, August 29th.) July 10th.

15,959. "Production of electro-deposits." B. LOWY and F. MULLER. (Convention date, June 1st, 1911, Austria.) July 10th. (Complete.)

15,999. "Dynamometers." G. WAZAU. (Convention date, July 10th, 1910, Germany.) July 10th. (Complete.)

16,007. "Automatic control of dynamo-electric machines in direct-current distributing and consumption systems." W. F. GRAFTON and E. P. PRIOR. July 10th. (Complete.)

16,026. "Sparking-plugs such as used on internal-combustion engines." E. VAUGHAN. July 11th.

16,065. "Electrocuting trap." H. HERTZBERG, A. A. LOW and M. J. WOHL. July 11th. (Complete.)

16,068. "Variable-speed dynamos, such as those employed for train lighting." ELECTRIC AND ORDNANCE ACCESSORIES Co., LTD., J. ETCHELLS and E. W. PRICE. July 11th.

16,075. "Telephone exchange systems." WESTERN ELECTRIC Co., LTD. (Western Electric Co., United States). July 11th. (Complete.)

16,078. "Switches." H. THIEL. July 11th. (Complete.)

16,081. "Electric plug connection." A. A. PRICE. July 11th.

16,088. "Systems for electrically controlling or operating clocks or the like." L. J. ARON. July 11th.

16,095. "Dynamometers, wattmeters, watt-hour meters, and the like." A. E. MOORE, T. E. GAMBRELL and C. T. GAMBRELL. July 12th.

16,096. "Contact-breakers for induction coils and other purposes." C. C. ELFORD. July 12th.

16,110. "Apparatus for the sterilisation of milk, beer, water, or other liquids by means of the ultra-violent rays." W. R. WALKEY. July 12th. (Complete.)

16,143. "Envelopes or supports for the resistances in electric-heating apparatus." C. O. BASTIAN. July 12th.

16,152. "Electrolytic preparation of sulphuric acid." B. BRADLEY. July 12th.

16,163. "Electric lamps." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) July 12th.

16,187. "Mercury or other vapour electric apparatus." J. S. ANDERSON and G. B. BURNSIDE. July 13th.

16,195. "Electric incandescent lamp." O. SCHALLER. (Convention date, July 13th, 1910, Germany.) July 13th. (Complete.)

16,228. "Fuses for electric circuits." E. A. GRAHAM. July 13th. (Complete.)

16,290. "Method of and apparatus for regenerating burnt-out carbon and metal-filament electric lamps." S. BLOCH. July 13th. (Complete.)

16,298. "Electric oscillographs." G. BOWRON. July 14th.

16,308. "Manufacture of metal filaments for electric lamps." E. R. GROTE. July 14th.

16,318. "Type of electric lampholder." J. WILSON and P. E. A. WARREN. July 15th.

16,343. "Method of and apparatus for controlling the speed of electro-motors." ELECTROMOTORS, LTD., and E. GRENHALGH. July 15th.

16,352. "Telephone call apparatus and the like." F. B. MITCHELL. July 15th.

16,355. "Direct-current transformers and the like." F. A. FRASER. July 15th.

16,361. "Control of alternating-current electric motors." R. H. BARBOUR. July 15th.

16,367. "Electric arc lamps." A. OGILVY-WEBB and R. C. A. REINECKE. July 15th. (Complete.)

16,374. "Traction electromagnets." H. W. LAKE. (D. L. Lindquist, United States.) July 15th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

ELECTRIC SWITCH. A. H. Johnson. 12,184. May 18th.

AUTOMATIC CONTACT DEVICE FOR USE IN CONNECTION WITH THE OVERHEAD EQUIPMENT OF ELECTRIC TRAMWAY INSTALLATIONS. J. Mathieson. 14,534. June 16th.

METHOD OF OBTAINING RAPIDLY VARYING ELECTRIC CURRENTS. J. T. Morris, R. M. Ellis and F. Murphy. 14,588. June 16th.

SLOW-MOTION DEVICES FOR USE IN CONNECTION WITH ELECTRIC CONTROLLERS, STARTING SWITCHES AND THE LIKE. Electric and Ordnance Accessories Co. and N. Collins. 14,625. June 17th.

COMBINED SPEED AND CURRENT REGULATORS FOR DYNAMO-ELECTRIC SERIES MACHINES. Campagnie de L'Industrie Electrique et Mecanique. 14,766. June 18th. (May 19th, 1910.)

CONTROLLERS FOR ELECTRIC MOTORS. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 14,851. June 20th.

CONSTRUCTION OF SMALL OR POCKET ELECTRIC LAMPS. W. Thomson. 15,004. June 22nd.

ARC LAMPS. F. Klostermann. 15,143. June 23rd. (June 26th, 1909.)

ENCLOSED ELECTRIC ARC LAMPS OF THE INVERTED TYPE. B. Quint. 15,710. June 30th.

INTERLOCKING SWITCH BOX FOR ELECTRIC LIGHTING OR POWER TRANSMISSION CABLES. W. Paton. 16,486. July 11th.

ELECTROLYTIC REDUCTION OF ORGANIC BODIES. H. Higgins. (Higgins) 18,962. August 12th.

GALVANIC BATTERY. D. W. John and J. H. Berry. 19,729. August 24th.

RECEIVING METHOD FOR WIRELESS TELEGRAPHY. W. O. Smith. (Huth.) 24,421. October 21st.

COLLECTORS FOR OVERHEAD CONDUCTOR ELECTRIC TRACTION SYSTEMS. H. Sefton-Jones. (Oesterreichische Daimler-Motoren Ges.) 25,012. October 27th.

PROCESS FOR PRODUCING ELECTRIC INCANDESCENCE BODIES. J. Krannichfeldt. 26,045. November 9th.

MANUFACTURE OF ELECTRIC ACCUMULATOR PLATES. J. Apoznanski. 27,176. November 22nd.

STREET OR STATION INDICATORS FOR ELECTRIC TRAINS, TRAMCARS AND THE LIKE. H. Alweis. 27,652. November 28th. (November 26th, 1909.)

GOVERNING OR CONTROLLING DEVICES FOR DYNAMOS. W. Gray. 28,246. December 5th.

ELECTRIC CURRENT GAUGES OR APPARATUS FOR MEASURING THE STRENGTH OF ELECTRIC CURRENT. W. Frisby. 28,994. December 14th.

ELECTRICAL ARRANGEMENTS FOR PROTECTING SHIPS' BOTTOMS AND SUBMERGED STRUCTURES FROM BARNACLES OR AQUATIC LIFE AND SUCH LIKE. J. E. James. 14,181. June 11th.

MAGNETO IGNITION DEVICES FOR INTERNAL COMBUSTION ENGINES. C. B. Redrup. 15,134. June 23rd.

TROLLEY POLES FOR ELECTRIC TRACTION ON THE OVERHEAD CONDUCTOR SYSTEM. A. R. Christian. 15,114. June 27th.

1911.

MEANS FOR ASCERTAINING THE POSITION OF THE CURRENT DISTRIBUTOR IN ELECTROMAGNETIC IGNITION DEVICES FOR EXPLOSION ENGINES. W. Sauerbrey. 790. January 11th. (January 12th, 1910.)

SENDER WITH DIRECT EXCITATION FOR RADIO-TELEGRAPHIC PLANTS. E. Girardeau. 3,949. February 16th. (July 30th, 1910.)

MEANS FOR FIXING AND INSULATING CONTACT SPRINGS FOR ELECTRICAL APPARATUS. Siemens Bros. & Co. and C. R. Ribber. 6,736. March 17th.

MEANS FOR FIXING AND INSULATING CONTACT SPRINGS FOR ELECTRICAL APPARATUS. Siemens Bros. and C. R. Ribber. 6,737. March 17th.

DEVICE FOR INSULATING THE TWISTED ENDS OF ELECTRIC WIRES. J. Krannichfeldt. 7,511. March 27th.